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Lake Calumet Cluster Site Group

Quality Assurance Project Plan

Lake Calumet Cluster Site

July 2015

Introduction

This Quality Assurance Project Plan (QAPP) presents general information on the organization, objectives, functional activities, and Quality Assurance (QA)/Quality Control (QC) activities associated with investigative activities outlined in the 2012 RI/FS Work Plan developed for the Lake Calumet Cluster Site (LCCS or Site). The QAPP was prepared in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP). It was developed using the *Workbook for Uniform Federal Policy for Quality Assurance Project Plans* prepared by the Intergovernmental Data Quality Task force. This QAPP details the steps required to achieve the data quality objectives (DQOs) of Site investigative activities. The QAPP describes the minimum procedures required to assure that the precision, accuracy, sensitivity, completeness, representativeness, and comparability of the chemical data collected are known and documented.

The purpose of the QAPP is to describe the guidelines to be followed in implementing investigative activities at the Site to ensure that (1) all chemical data collected (and decisions made based on those data) are technically sound, valid, and properly documented, and (2) to ensure that project sampling and analysis activities are consistent with project DQOs. As such, the QAPP is considered a Site guidance document for data collection as proposed in investigation work plans. However, investigation work plans for the Site may contain more detailed sampling information and scopes of work. This QAPP will be used as a reference for general items to be addressed in investigation work plans and general data quality requirements. As investigation work plans are developed or revised for the Site, the QAPP will be reviewed to determine if updates are needed. Changes to this QAPP may be necessary to accommodate such items as modified regulatory requirements, technology, or project objectives. Potential changes could include revised analytical methods, lower or higher reporting limits, analyte list additions or exclusions, or different QC criteria.

This QAPP will be sent to all individuals on the distribution list. This QAPP is also supported by the individual SOPs and the Laboratory Quality Manuals (LQMs) provided as appendices.

Quality Assurance Project Plan Worksheet #1 – Title and Approval Page

Site Name/Project Name:	Lake Calumet Cluster Site
Site Location:	The Lake Calumet Cluster Site is located in a heavily industrialized area in southeastern Chicago, Illinois. The Site consists of an aggregation of four separate parcels (Alburn Incinerator, U.S. Drum, the Unnamed Parcel, and the Paxton Lagoons). The Site has a long history of waste disposal activities dating back more than a century. Documents indicate that nearby industries disposed of slag and other wastes that raised the ground surface to just above the water table. The Alburn Incinerator was operated as an industrial waste incinerator and storage facility. The U.S. Drum facility has been used as a dump for municipal and industrial wastes since the 1940s as well as a waste transfer and solvent recovery facility. The Paxton Lagoons were used as an industrial disposal site.
Document Title:	*Quality Assurance Project Plan, July 2015* *Lake Calumet Cluster Site, Chicago, IL*
Lead Organization:	United States Environmental Protection Agency (USEPA), Region 5
Preparer's Name and Organizational Affiliation:	Ellyn Gates, ARCADIS
Preparer's Contact Information:	10 S Riverside Drive, Suite 1900, Chicago, IL 60606. 312.575.3772. ellyn.gates@arcadis-us.com
Preparation Date:	June 2015
Investigative Organization's Project Manager:	Signature Jack Kratzmeyer, ARCADIS
Investigative Organization's Project Quality Assurance Officer:	Signature Todd Church, ARCADIS
Lead Organization's Program Manager (Remedial Project Manager):	Signature Shari Kolak, USEPA Region 5

Document Control Number: CI001805.0001.00001

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

Site Name/Project Name:	Lake Calumet Cluster Site
Site Location:	The Lake Calumet Cluster Site is located in a heavily industrialized area in southeastern Chicago, Illinois. The Site consists of an aggregation of four separate parcels (Alburn Incinerator, U.S. Drum, the Unnamed Parcel, and the Paxton Lagoons). The Site has a long history of waste disposal activities dating back more than a century. Documents indicate that nearby industries disposed of slag and other wastes that raised the ground surface to just above the water table. The Alburn Incinerator was operated as an industrial waste incinerator and storage facility. The U.S. Drum facility has been used as a dump for municipal and industrial wastes since the 1940s as well as a waste transfer and solvent recovery facility. The Paxton Lagoons were used as an industrial disposal site.
Site Number/Code:	NA
Operable Unit:	NA
Contractor Name:	ARCADIS U. S., Inc. (ARCADIS)
Contractor Number:	NA
Contract Title:	NA
Work Assignment Number:	NA
Identify guidance used to prepare Quality Assurance Project Plan (QAPP):	Uniform Federal Policy for Quality Assurance Project Plans, Manual V1 (2005)
Identify regulatory program:	CERCLA
Identify approval entity:	USEPA Region 5
Indicate whether the QAPP is a generic or a project-specific QAPP?	This is a project-specific QAPP. This QAPP may be updated, as required, for future work at the site.

Quality Assurance Project Plan Worksheet #2 – Quality Assurance Project Plan Identifying Information

List dates of scoping sessions that were held:	June 4, 2015
List dates and titles of QAPP documents written for previous site work, if applicable:	
Quality Assurance Project Plan:	None
List organizational partners (stakeholders) and connection with lead organization:	USEPA Region 5
List data users:	USEPA Region 5, Lake Calumet Cluster Site Group and ARCADIS
Lead organization's Program Manager:	Shari Kolak, USEPA Region 5

Quality Assurance Project Plan Worksheet #2 - Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	Worksheet #1 Title and Approval Page
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	The Table of Contents is provided following the QAPP cover page Worksheet #2 QAPP Identifying Information
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	Worksheet #3 Distribution List and Worksheet #4-1 through #4-2 Project Personnel Sign-Off
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	Worksheet #5 Project Organization Chart, Worksheet #6 Communication Pathways, Worksheet #7 Personnel Responsibilities and Qualifications Worksheet #8 Special Personnel Training Requirements
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History and Background	- Project Planning Session Documentation (including data needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History and Background - Site Maps (historical and present)	Worksheet #9 Project Team Planning Sessions Participants Sheet and Worksheet #10 Problem Definition for Project Data Quality Objectives (DQOs) Site Maps are provided in the RI/FS Work Plan.

Quality Assurance Project Plan Worksheet #2 - Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific Project Quality Objectives - Measurement Performance Criteria Table	Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements and TestAmerica SOPs
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	Worksheet #13 Secondary Data Criteria and Limitations
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	Worksheet #14 Summary of Project Tasks, Worksheet #15-1 through #15-2 Reference Limits and Evaluation for specific monitoring activities and Worksheet #16 Project Schedule/Timeline

Quality Assurance Project Plan Worksheet #2 - Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control (QC) Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing and Inspection Table	Worksheet #17 Sampling Design and Rationale, Worksheet #18 Sampling Locations and Methods/SOP Requirements for the project, Worksheet #19 Analytical SOP Requirements Sample Containers Preservation and Holding Times Worksheet #20 Sample Quantities and Control Frequencies Worksheet #21 Field Sampling SOP References Worksheet #22 Field Equipment Calibration, Maintenance, Testing and Inspection The analytical SOPs can be found in Appendix A to this QAPP The field sampling SOPs are presented in the Field Sampling Plan.
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing and Inspection Table	Worksheet #23 Analytical SOP References, Worksheet #24 Analytical Instrument Calibration and Worksheet #25 Analytical Instrument and Equipment Maintenance, Testing and Inspection The analytical SOPs can be found in Appendix A to this QAPP

Quality Assurance Project Plan Worksheet #2 - Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
3.3 Sample Collection Documentation, Handling, Tracking and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody (COC) Form and Seal	Worksheet #26 Sample Handling System and Worksheet #27 Sample Custody Requirements Details concerning the field sampling procedures and the field sampling SOPs are presented in Appendix D of the Site Investigation Workplan; Former ECI Refinery (May 2015). A COC form is included in the field SOP: Chain-of Custody, Handling, Packing and Shipping, located in the Field Sampling Plan.
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	Worksheet #28-1 through #28-9 present QC sample information for project analytes
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	Worksheet #29 Project Documents and Records and Worksheet #30 Analytical Services Data Management Plan is presented in Worksheet #14.

Quality Assurance Project Plan Worksheet #2 - Quality Assurance Project Plan Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	Worksheet #31 Planned Project Assessments and Worksheet #32 Assessment Findings and Corrective Action Responses
4.2 QA Management Reports	- QA Management Reports Table	Worksheet #33 QA Management Reports

Quality Assurance Project Plan Worksheet #2 - Quality Assurance Project Plan Identifying Information

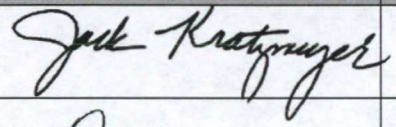
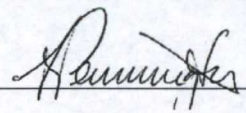
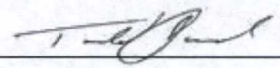
Required QAPP Element(s) and Corresponding QAPP Section(s) (per Uniform Federal Policy QAPP 2005)	Required Information	Crosswalk to Related Information and Documents
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	Worksheet #34 Verification (Step I) Process, Worksheet #35 Validation (Steps IIa and IIb) Process, Worksheet #36 Validation (Steps IIa and IIb) Summary and Worksheet #37 Usability Assessment
5.3 Streamlining Data Review 5.3.1 Data Review Steps to be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	None	NA

Quality Assurance Project Plan Worksheet #3 – Distribution List

Quality Assurance Project Plan (QAPP) Recipients	Title	Organization	Telephone Number	E-mail Address
Shari Koloak	USEPA Remedial Project Manager	United States Environmental Protection Agency (USEPA) Region 5	312.886.6151	kolak.shari@epa.gov
Leo Brausch	Project Coordinator	Brausch Environmental	704.246.7266	lbrausch@brauschenv.com
Jack Kratzmeyer	Project Manager	ARCADIS	312.575.3721	jack.kratzmeyer@arcadis-us.com
Andy Pennington	Feasibility Study Task Manager	ARCADIS	312.575.3752	andy.pennington@arcadis-us.com
Tom Darby	Remedial Investigation Task Manager	ARCADIS	864.987.3918	thomas.darby@arcadis-us.com
Amber Stojak	Risk Assessment Task Manager	ARCADIS	865.777.3554	amber.stojak@arcadis-us.com
Matt Anderson	Health & Safety Manager	ARCADIS	312.575.3756	matt.anderson@arcadis-us.com
Todd Church	Data Manager	ARCADIS	315.671.9627	Todd.church@arcadis-us.com
Bonnie Stadelmann	Laboratory Project Manager	TestAmerica	708.534.5200	bonnie.stadelmann@testamericainc.com

Note: The QAPP will be distributed to the individuals listed above. This includes and subsequent revisions.

Quality Assurance Project Plan Worksheet #4-1 – Project Personnel Sign-Off (ARCADIS)

Organization/Project Personnel	Title	Telephone Number	Signature	Date Quality Assurance Project Plan (QAPP) Read
Jack Kratzmeyer	Project Manager	312.575.3721		7/16/2015
Andy Pennington	Remedial Investigation Task Manager	312.575.3752		7/16/2015
Todd Church	Data Manager	315.671.9627		7/16/2015

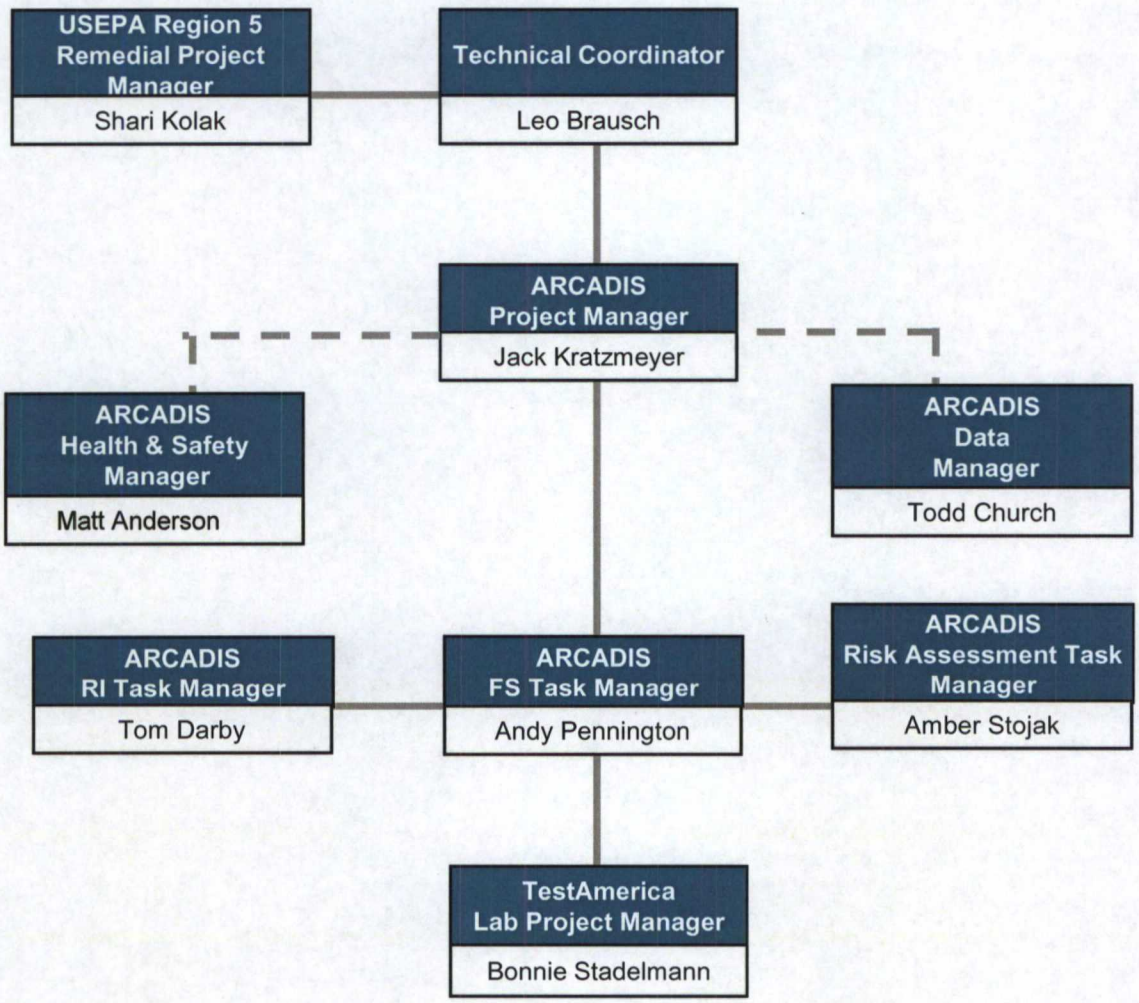
Note: The project personnel sign-off table above documents key project personnel who have read the applicable sections of, and will perform required activities in accordance with the QAPP.

Quality Assurance Project Plan Worksheet #4-2 – Project Personnel Sign-Off (TestAmerica)

Organization/Project Personnel	Title	Telephone Number	Signature	Date Quality Assurance Project Plan (QAPP) Read
Bonnie Stadelmann	Laboratory Project Manager	708.534.5200	Bonnie Stadelmann	07/17/15

Note: The project personnel sign-off table above documents key project personnel who have read the applicable sections of, and will perform the tasks as described in the QAPP.

Worksheet #5: Project Organization Chart



Quality Assurance Project Plan Worksheet #6 – Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (e.g., Timing, Pathways)
Point of Contact with United States Environmental Protection Agency (USEPA)	Respondent's Technical Project Coordinator	Leo Brausch	704.246.7266	Will provide documents to USEPA
Manage all Project Phases	Project Manager	Jack Kratzmeyer ARCADIS	312.575.3721	Will serve as the ARCADIS liaison to Respondent's Project Coordinator
	FS Task Manager	Andy Pennington ARCADIS	312.575.3752	
Reporting Lab Data Quality Issues	Laboratory Quality Assurance (QA) Manager	Bonnie Stadelmann TestAmerica	708.534.5200	Will report all QA/Quality Control (QC) issues with project field samples to Project Managers and Project QA Managers, as appropriate within two business days.
Field and Analytical Corrective Actions	Data Task Manager	Todd Church ARCADIS	315.671.9627	Will evaluate the need for corrective action for field and analytical issues in conjunction with the Project Manager or Laboratory QA Manager, as appropriate.
Release of Analytical Data	Data Task Manager	Todd Church ARCADIS	315.671.9627	Will approve release of final analytical data.

Quality Assurance Project Plan Worksheet #6 – Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (e.g., Timing, Pathways)
QAPP Amendments	Data Task Manager	Todd Church ARCADIS	315.671.9627	Will approve major changes to the QAPP in conjunction with the Project Managers, Respondents' Project Coordinator and USEPA RPM before the changes are implemented.

Note: As stated in the Health and Safety Plan (HASP), every ARCADIS employee, subcontractor, and client representative at the site has the responsibility to stop the work of a coworker or subcontractor if issues (e.g. change in working conditions, employee behavior) arise.

Quality Assurance Project Plan Worksheet #7 – Personnel Responsibilities and Qualifications

Name	Title	Organizational Affiliation	Education and Experience Qualifications
Shari Kolak	USEPA Remedial Project Manager	United States Environmental Protection Agency (USEPA) Region 5	Designated as the USEPA's RPM
Leo Brausch	Respondents' Project Coordinator	Brausch Environmental	Representative for the Respondents
Jack Kratzmeyer	Project Manager	ARCADIS	Certified project manager; 24 years experience
Andy Pennington	FS Task Manager	ARCADIS	B.A. Environmental Science; 10 years experience
Todd Church	Data Task Manager	ARCADIS	B.S. Environmental Science; 28 years of experience
Matt Anderson	Health & Safety Manager	ARCADIS	
Bonnie Stadelmann	Laboratory Project Manager	TestAmerica	

Notes:
Resumes for key ARCADIS personnel are available upon request. The responsibilities of the various ARCADIS and subcontractor team members are summarized below by organization.

ARCADIS

Project Manager
Responsibilities and duties include:
- primary liaison with the Respondent's Project Coordinator and conducts regular active status meetings
- ensuring that all activities are conducted in accordance with contractual specifications
- ensuring compliance with project scope, schedule and budget

- coordinating project team
- managing subcontractors
- managing staff, materials and equipment
- ensuring that all personnel assigned the project, including subcontractors, review the technical plans before any task associated with the project is initiated and possess requisite training and certification
- participating in the development of the field program, evaluation of data, reporting, and the development of conclusions and recommendations

Task Manager
Responsibilities and duties include:
- managing subcontractors
- managing staff, materials and equipment
- ensuring that all personnel assigned the project, including subcontractors, review the technical plans before any task associated with the project is initiated and possess requisite training and certification
- participating in the development of the field program, evaluation of data, reporting, and the development of conclusions and recommendations

Data QA Manager
Responsibilities and duties include:
- ensuring that the QA/QC procedures and objectives in the project-specific work plans are met
- ensuring management and staff are cognizant of associated QA/QC policies and procedures
- reviewing field and analytical data to ensure adherence to QA/QC procedures
- ensuring the quality of data before inclusion into associated reports
- assessing field and laboratory audits during the investigation
- reviewing, evaluating, and validating (if performed) analytical data for the project and participating in interpreting and presenting analytical data
- providing technical guidance to direct other team members on a day-to-day or as-needed basis to ensure the application of QA/QC procedures

Health & Safety Manager
Responsibilities and duties include:
- developing, implementing and monitoring HASP procedures
- ensuring field activities are in compliance with HASP requirements
- implementing corrective actions to ensure an accident free work environment

ARCADIS Subcontractor (i.e., TestAmerica.)

Analytical Laboratories
General responsibilities and duties of the analytical laboratories include:
- performing sample analyses and associated laboratory QA/QC procedures
- supplying sample containers and shipping coolers
- maintaining laboratory custody of sample
- adhering to all protocols in the QAPP

Laboratory Project Manager
Responsibilities and duties include:

- serving as primary communication link between ARCADIS and laboratory technical staff
- coordinating activities of all laboratories including subcontractors
- monitoring workloads and maintaining availability of resources
- overseeing preparation of analytical reports
- supervising in-house chain-of-custody

Laboratory QA Manager
Responsibilities and duties include:

- monitoring the day-to-day quality of data produced by the laboratory for this project
- ensuring and documenting the reliability of the data
- maintaining and reviewing quality control data
- conducting audits of all laboratory activities, data packages and deliverables

Quality Assurance Project Plan Worksheet #8 – Special Personnel Training Requirements

Project Function	Specialized Training	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Activities	40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER), Department of Transportation (DOT) Training, Site-Specific Training, and ARCADIS H&S Orientation[1]	Certified Training Professionals	NA	Field personnel	ARCADIS personnel	ARCADIS project offices: Chicago, Illinois
Analytical Chemistry	National Environmental Laboratory Accreditation Program (NELAP) Accreditation[2]	Primary Accrediting State	NA	NA	TestAmerica	TestAmerica
Additional training/certification requirements are listed in the *Health and Safety Plan* (HASP)						

Notes:

[1]Current HAZWOPER training certificates will be maintained electronically in a company database for each employee performing work at the site where 40-hour training is required for the position assignment. Certificates for field personnel will be made available upon request to the USEPA when the field work commences.

[2]The current certifications are included in Appendix A of this QAPP.

Quality Assurance Project Plan Worksheet #9 – Project Team Planning Sessions Participants Sheet

Project Name: Lake Calumet Cluster Site	**Site Name:** Lake Calumet Cluster Site
Projected Date(s) of Sampling: 2015-2016	**Site Location:** The Lake Calumet Cluster Site is located in a heavily industrialized area in southeastern Chicago, Illinois. The Site consists of an aggregation of four separate parcels (Alburn Incinerator, U.S. Drum, the Unnamed Parcel, and the Paxton Lagoons). The Site has a long history of waste disposal activities dating back more than a century. Documents indicate that nearby industries disposed of slag and other wastes that raised the ground surface to just above the water table. The Alburn Incinerator was operated as an industrial waste incinerator and storage facility. The U.S. Drum facility has been used as a dump for municipal and industrial wastes since the 1940s as well as a waste transfer and solvent recovery facility. The Paxton Lagoons were used as an industrial disposal site.
Project Manager: Jack Kratzmeyer	
Date of Session: May 2015	
Scoping Session Purpose: Discussed the QAPP requirements.	

Name	Title	Affiliation	Phone	E-mail Address	Project Role
Jack Kratzmeyer	Program Manager	ARCADIS	312.575.3721	jack.kratzmeyer@arcadis-us.com	Project Manager
Andy Pennington	Project Scientist	ARCADIS	312.575.3752	andy.pennington@arcadis-us.com	Task Manager
Ellyn Gates	Project Engineer	ARCADIS	312.575.3772	Ellyn.gates@arcadis-us.com	QAPP Preparer

Quality Assurance Project Plan Worksheet #10 - Problem Definition – Data Quality Objectives

Step 1: State the Problem
The purpose of this QAPP and associated RI/FS Work Plan for the Lake Calumet Cluster Site (the site) is to present the sampling rationale, design, and quality assurance and quality control procedures to be followed as part of site investigation activities. The QAPP and work plan presents the investigation strategy and proposed methods for the assessment of current conditions at the site to support future remedial decision making.
Step 2: Identify the Goal of the Study
The goal of the site investigation is to investigate the nature and extent of contamination. The data collected as part of the investigation and previous data shall be used to develop final removal measures to minimize and mitigate potential risks.
Step 3: Identify Information Inputs
Field data that will be collected as part of the site investigation include water level, water quality parameters such as DO and ORPD, and soil classification. ARCADIS Standard Operating Procedures (SOPs) applicable to the site investigation work are listed in Worksheet #21. Vertical aquifer profile samples will be analyzed for TCL VOCs, dissolved metals and ammonia. Groundwater samples will be collected from newly installed monitoring wells and analyzed for VOCs, SVOCs, PCBs, pesticides, TAL metals, Nitrogen compounds, geochemical parameters and dissolved gases. ARCADIS SOPs for collection, handling, and shipping of these samples are listed on Worksheet #21.
Step 4: Define the Boundaries of the Sampling
Samples will be collected from the temporary wells established during the HPT analysis. The locations of the monitoring wells to be sampled will be determined following the Phase II work.
Step 5: Develop the Analytic Approach
The required reporting limits are documented in Worksheet #15 so that the lowest achievable detection limit will be reported by the laboratory.
Step 6: Specify Performance or Acceptance Criteria
Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability and 2) understanding the representative

**Quality Assurance Project Plan Worksheet #10 -
Problem Definition – Data Quality Objectives**

nature of the sampling design. Corrective actions are described within this document. The representative nature of the sampling design has been assured by discussions among professionals familiar with the site and the appropriate government agencies.

There are no if, then statements during the site investigation. Data will be used to support future remedial decision making.

Step 7: Develop the Plan for Obtaining Data

The proposed investigation has multiple elements, including assessment and delineation of impacts, measurement of hydraulic conductivity, and observation of soil properties. Collectively, these analyses will support the evaluation of remedial alternatives. The overall QA objective is to develop and implement procedures for field sampling (e.g., chain-of-custody, laboratory analysis and reporting). Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, data reporting, internal QC, audits, preventive maintenance of field equipment and corrective action are described in other sections of this QAPP.

Quality Assurance Project Plan Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?
Lake Calumet Cluster Site Group, ARCADIS and overseeing agencies will use the data.
What will the data be used for?
The data will be used to investigate the nature and extent of contamination at the Site.
What type of data is needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)
Field data that will be collected as part of the site investigation include water level and soil classification. ARCADIS Standard Operating Procedures (SOPs) applicable to the site investigation work are listed in Worksheet #21. Vertical aquifer profile samples will be analyzed for VOCs, ammonia and dissolved metals.
How "good" do the data need to be in order to support the environmental decision?
The data need to be of sufficient quality to meet data quality objectives of the site investigation as described in the laboratory SOPs and Worksheet #28. Analytical reporting limits for all parameters should be sufficiently low to achieve screening criteria.
How much data are needed? (number of samples for each analytical group, matrix and concentration)
The number of samples and analyses for each media are summarized in Worksheet #20.
Where, when, and how should the data be collected/generated?
Sampling and investigation will begin following USEPA approval.

Quality Assurance Project Plan Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements

Who will collect and generate the data?
ARCADIS and subcontractors
How will the data be reported?
ARCADIS will submit a Summary Report as described in the SIWP.
How will the data be archived?
The Project Manager will be responsible for archiving data for this project. The data will be archived in the ARCADIS office located in Chicago, IL. Data will be preserved for six years after completion of removal actions as required by the Administrative Order on Consent. At the end of the six year period, USEPA will be notified at least thirty days before the data is destroyed that such data will be available for inspection. Upon request, USEPA will be provided with the originals or copies of the data.

Quality Assurance Project Plan Worksheet #12-1 – Measurement Performance Criteria (Volatile Organic Compounds [VOCs] in Water)

Matrix	Water
Analytical Group	VOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-4, F-6	SW846 8260B/ L-1	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias	Laboratory-generated limits	Surrogate	A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, trip, equipment, method)	S&A
		Accuracy/Bias	Laboratory-generated limits	Laboratory control sample (LCS)	A
		Accuracy/Bias	% Relative abundance, see analytical SOP	Instrument performance check: Bromofluorobenzene (BFB)	A
		Precision	Area response and retention times, see analytical SOP	Internal standard	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike (MS)[3]	A
		Accuracy/Bias	Laboratory-generated limits	Matric spike duplicate (MSD) or laboratory control sample duplicate (LCSD)[3]	A
		Precision	Laboratory-generated limits	MS/MSD or LCS/LCSD[3]	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Quality Assurance Project Plan Worksheet #12-2 – Measurement Performance Criteria (Semi-Volatile Organic Compounds [SVOCs] in Water)

Matrix	Water
Analytical Group	SVOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-6	SW846 8270D/ L-2	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias	Laboratory-generated limits	Surrogate	A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Laboratory-generated limits	Laboratory control sample (LCS)	A
		Accuracy/Bias	% Relative abundance, see analytical SOP	Instrument performance check: decafluorotri-phenylphosphine (DFTPP)	A
		Precision	Area response and retention times, see analytical SOP	Internal standard	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike (MS)[3]	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD)[3]	A
		Precision	Laboratory-generated limits	MS/MSD or LCS/LCSD[3]	A

Notes:
[1]Reference number from Quality Assurance Project Plan Worksheet #21.
[2]Reference number from Quality Assurance Project Plan Worksheet #23.
[4]MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Quality Assurance Project Plan Worksheet #12-3 – Measurement Performance Criteria (Pesticides in Water)

Matrix	Water
Analytical Group	Pesticides
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-6	SW846 8081B/ L-3	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias	Laboratory-generated limits	Surrogate	A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Laboratory-generated limits	Laboratory control sample (LCS)	A
		Accuracy/Bias and Precision	Retention times, see analytical SOP	Retention time windows	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike (MS)[3]	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD)[4]	A
		Precision	Laboratory-generated limits	MS/MSD or LCS/LCSD[4]	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Quality Assurance Project Plan Worksheet #12-4 – Measurement Performance Criteria (Polychlorinated Biphenyls [PCBs] in Water)

Matrix	Water
Analytical Group	PCBs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria[3]	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-6	SW846 8082A/ L-4	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias	Laboratory-generated limits	Surrogate	A
		Accuracy/Bias Contamination	< Report limit (RL)	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Laboratory-generated limits	Laboratory control sample (LCS)	A
		Accuracy/Bias and Precision	Retention times, see analytical SOP	Retention time windows	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike (MS)[3]	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD)[3]	A
		Precision	Laboratory-generated limits	MS/MSD or LCS/LCSD[3]	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] Sufficient sample size for MS and MSD analysis must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Quality Assurance Project Plan Worksheet #12-5 – Measurement Performance Criteria (Metals in Water)

Matrix	Water
Analytical Group	Metals
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-4, F-6	SW-846 6010B/7470A, L-5, L-6	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, calibration, method)	S&A
		Accuracy/Bias	Percent recovery (%R): 90-110%; mercury 80-120%	Initial and continuing calibration verification	A
		Precision – lab	Certain metals %R: 80-120%; see analytical SOP	Interference check sample (A and AB)	A
		Precision – lab	%R: 70-130%	Reporting limit verification (CRI)	A
		Accuracy/Bias	%R: 75-125%	Matrix spike (MS) and matrix spike duplicate (MSD)[3]	A
		Precision	RPD <20%	MS/MSD	A
		Accuracy/Bias	%R: 80-120%	Laboratory control sample (LCS)	A
		Accuracy/Bias	%R: 75-125%	Post-digestion spike	A
		Precision	Percent difference (%D)< 10%	Serial dilution[4]	A

Notes:

[1] Reference number from Quality Assurance Project Plan (QAPP) Worksheet #21.
[2] Reference number from QAPP Worksheet #23.
[3] Sufficient sample size for MS and MSD analysis must be client-provided. LCS/LCSD performed when no MSs/MSDs are supplied
[4]Performed as needed only for analytes with concentration > 50 times the method detection limit.

Quality Assurance Project Plan Worksheet #12-6 – Measurement Performance Criteria (Dissolved Gases in Water)

Matrix	Water
Analytical Group	Dissolved Gases
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria[3]	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-6	RSK-175/L-7	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< Report limit (RL)	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Laboratory-generated limits	Laboratory control sample (LCS)	A
		Accuracy/Bias and Precision	Retention times, see analytical SOP	Retention time windows	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike (MS)[3]	A
		Accuracy/Bias	Laboratory-generated limits	Matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD)[3]	A
		Precision	Laboratory-generated limits	MS/MSD or LCS/LCSD[3]	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] Sufficient sample size for MS and MSD analysis must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Quality Assurance Project Plan Worksheet #12-7 – Measurement Performance Criteria (Wet Chemistry, Water Quality Parameters)

Matrix	Water
Analytical Group	Wet Chemistry
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedures (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
F-4, F-6	Sulfate: SW-846 9038/L-8 Sulfide: SW-846 9034/L-9 Total Suspended Solids: SM 2540D/L-11 Total Organic Carbon: SW-846 9060/L-10 Ammonia: SM 4500NH3_G/L-12	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< Reporting limit (RL)	Blanks (field, equipment, calibration, method)	S&A
		Accuracy/Bias	Percent recovery (%R): 90-110%	Initial and continuing calibration verification	A
		Accuracy/Bias	%R: 75-125%	Matrix spike (MS) and matrix spike duplicate (MSD)[3]	A
		Precision	RPD <20%	Laboratory duplicate or MS/MSD[3]	A
		Accuracy/Bias	%R: 80-120%	Laboratory control sample (LCS)	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] Sufficient sample size for MS/MSD or laboratory duplicate analysis must be client-provided. LCS/LCSD performed when no MS/MSD or laboratory duplicate are supplied.

Quality Assurance Project Plan Worksheet #13 – Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used?	Limitations on Data Use
Indian Ridge Marsh toxicity analysis	2009 Ecotoxicological Evaluation of Indian Ridge Marsh in Chicago, Illinois	Tetra Tech EM	Historical data may be used with data collected as part of this QAPP to assist with remedial decisions.	None
Field measurements, observations, and analytical results from past data collection	Ecology and Environment, Inc. 1999. The Nature and Extent of Contamination at the Lake Calumet Cluster Site, Chicago, Cook County, Illinois, November 30.	Ecology and Environment	Historical data may be used with data collected as part of this QAPP to assist with remedial decisions.	None
Field measurements and observations from past data collection	Ecology and Environment, Inc. 2007. Groundwater Investigation Summary Report, Lake Calumet Cluster Site, Chicago, Illinois. Prepared for IEPA, Springfield, Illinois. May.	Ecology and Environment	Historical data may be used with data collected as part of this QAPP to assist with remedial decisions.	None

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Sampling Tasks
• Phase 1: Improve understanding of groundwater flow patterns at the Site. This phase includes the installation and surveying of piezometers, as well as gauging events. • Phase 2: This phase will consist of a combination of HPT and VAP borings to characterize the hydrostratigraphic framework, to evaluate the vertical and lateral constituent mass distribution and to identify the potential groundwater transport pathways. • Phase 3: Installation of new groundwater monitoring wells and sampling of those wells. This will allow for characterization of the groundwater at the site. See the FSP for detailed information on the sampling tasks.
Analysis Tasks
See Worksheet #20 for parameters and methods for groundwater sampling. Samples will be processed, prepared and analyzed by TestAmerica Laboratories.
Quality Control Tasks
The samples will be collected and submitted to the laboratories for analysis. Waste created during the sampling activities will be processed with waste being transported and disposed of off-site in accordance with all regulations. The QA/QC samples are described in Worksheet #20.
Secondary Data
See Worksheet #13.

Quality Assurance Project Plan Worksheet #14 – Summary of Project Tasks

Data Management Tasks

The purpose of data management is to confirm that the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The site investigation (SI) work will include a number of samples that require a structured, comprehensive and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected, such that the data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements: 1) sample designation system, 2) field activities, 3) sample tracking and management, 4) data management system, and 5) document control and inventory.

Sample Designation System

A concise and easily understandable sample designation system is an important part of project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy resampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sampled collected, as outlined below.

Sample Codes

Each sample will be identified by a unique sample identification number in the logbook, sampling log, and chain-of-custody (COC) record using an alphanumeric code. Field samples will be linked to geographic location via location codes. Where possible, location codes will link historical sample data with new data. All field samples will be identified using the following convention presented below:

VAP identification will be as follows:

Example: VAP-N-MMDDYY

Where:

N - designates sequential number for each sample; and

MMDDYY - designates date of collection presented as month, day, year.

For monitoring well samples:
Example: LOC-XX-MMDDYY

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Where:

LOC - designates sample location (i.e., AMW-7D, etc.);

XX - designates types of sample (GW-groundwater); and

MMDDYY - designates date of collection presented as month, day, year.

In addition to the above nomenclature, the COC will be completed to include both the Sample Type and Sample Matrix. Field QA/QC samples will be identified as follows:

- DUP = field duplicate;
- FB = field blank; and
- TB = trip blank.

Field Activities

Field activities require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security and QA/QC. These procedures are described in further detail in the following subsections.

Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and assessment process. To confirm that the field investigation is thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including:

- field logs;
- COC forms; and
- instrument calibration records.

Each of these types of field documentation is described below.

Field Logs

Personnel performing the field activities will keep field logs that detail observations and measurements made during the site work. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To determine, at a future date, that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it and then

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documenting the proper information.

Chain-of-Custody Forms

COC forms are used to document and track sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the project files. Field personnel will be briefed on the proper use of the COC procedure.

Instrument Calibration Records

As part of data QA procedures, field monitoring and detection equipment will be routinely calibrated (at least once per day and when malfunction is suspected). Instrument calibration confirms that equipment used is of the proper type, range, accuracy and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Worksheet #22. To demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:

- calibration date and time;
- type and identification number of equipment;
- calibration frequency and acceptable tolerances;
- identification of individual(s) performing calibration;
- reference standards used;
- calibration data; and
- information on calibration success or failure.

The calibration record will serve as a written account of monitoring or detection equipment QA. Erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

Data Security

Measures will be taken during the field investigation to confirm that samples and records are not lost, damaged or altered. When not in use, field notebooks will be stored at the field office or locked in the field vehicle. Access to these files will be limited to the field personnel who use them.

Sample Management and Tracking

A record of all field documentation will be maintained to confirm the validity of data used in the site analysis. To effectively execute such

Quality Assurance Project Plan Worksheet #14 – Summary of Project Tasks

documentation, specific sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms. The completed COC forms associated with samples collected will be maintained by the appropriate Task Manager. Copies of all completed COC forms will be maintained in the project file. If samples are not hand delivered, the laboratory will verify receipt of the samples electronically (via e-mail) on the following day.

When analytical data are received from the laboratory, the appropriate Data QA Manager will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed up by the Data QA Manager.

Data Management System

In addition to the sample tracking system, a data management system will be implemented. The central focus of the data management system will be the development of a personal computer-based project database. The project database will combine pertinent geographical, field and analytical data. Information that will be used to populate the database will be derived from field observations and analytical results. Each of these sources is discussed in the following sections.

Computer Hardware

The database will be constructed on personal computer work stations connected through a network server. The network will provide access to various hardware peripherals, such as laser printers, backup storage devices, image scanners and modems. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

Computer Software

The data will be warehoused in EQuIS 5 database. Geographic information system (GIS) applications will be developed in ESRI ArcGIS. Tables and other database reports will be generated through EQuIS in conjunction with Microsoft Excel. These software products will be upgraded to current industrial standards, as necessary.

Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field. Following each sampling event, a status memorandum or email will be prepared by the field personnel who performed the sampling activities. The purpose of the status memo is to summarize and provide a record of the sampling event. Topics to be discussed include the locations sampled, the sampling methodologies used, QA/QC procedures, blind duplicate and MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy events that occurred.

Tables are typically attached to the memorandum or email and are used to summarize measurements that were recorded in the field books. It is anticipated that these tables will be developed using a personal computer spreadsheet program to reduce possible transcription error and to facilitate

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the transfer of information to the data management system.

All pertinent field data will be manually entered into the appropriate database tables from the COC forms and field notebooks.

Analytical Results

Analytical results will be provided by the laboratory in both a digital, and a hard copy or pdf format. The data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the Data QA Manager will be notified and will promptly follow up with the laboratory to resolve any issues.

Each data package may undergo a usability assessment in accordance with procedures outlined in Worksheet #37. Data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of the data may not necessarily be restricted.

Following completion of the usability assessment, the digital files will be used to populate the appropriate database tables. This format specifies one data record for each constituent for each sample analyzed.

Specific fields include:

- sample identification number;
- date sampled;
- date analyzed;
- parameter name;
- analytical result;
- units;
- detection limit; and
- qualifier(s).

The individual electronic data deliverables (EDDs), supplied by the laboratory in a defined four file EQuIS format value in a Microsoft Excel worksheet, will be loaded into the appropriate database table. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

Data Analysis and Reporting

The database management system will have several functions to facilitate the review and analysis of project data. Data entry screens will be developed to assist in the keypunching of field observations. Routines will also be developed to permit the user to scan analytical data from a given site for a given medium. Several output functions that have been developed will be appropriately modified for use in the data management system.

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A valuable function of the data management system will be the generation of tables of analytical results from the project database. The capability of the data management system to directly produce tables reduces the redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. This data management system function creates the ability to process the data and generate a table of rows and columns. Tables of analytical data will be produced as part of data interpretation tasks, the reporting of data and generation of reports.

Another function of the data management system will be to create digital files of analytical results and qualifiers suitable for transfer to mapping/ presentation software. The digital file will consist of sample location number, state plane coordinates, sampling date and detected constituents, and associated concentrations and analytical qualifiers. The file is then transferred to an AutoCAD work station, where another program has been developed to plot a location's analytical data in a "box" format at the sample location (represented by the state plane coordinates). This routine greatly reduces the redundant keypunching of analytical results and facilitates the efficient production of interpretative and presentation graphics.

The data management system also has the capability of producing a digital file of select parameters that exists in one or more of the databases. This type of custom function is accomplished on an interactive basis and is best used for transferring select information into a number of analysis tools, such as statistical or graphing programs.

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Documentation and Records

Field Sample Identification. This is described above in the Sample Codes section.

Field Documentation. Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis and sample COC. This documentation constitutes a record that allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the project are described below.

- *Daily Production Documentation*. A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.
- *Sampling Information*. Detailed notes will be made as to the exact sampling location, physical observations and weather conditions (as appropriate).
- *Sample COC*. The COC forms will provide the record of responsibility for sample collection, transport and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites or at the end of each day of sampling by field personnel designated to be responsible for sample custody. If the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample COC form is included in Appendix B of this QAPP.

  Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.
- *Field Equipment, Calibration and Maintenance Logs*. To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

Laboratory Project Files. The laboratory will establish a file for pertinent data. The file will include correspondence, faxed information, phone logs and COC forms. The laboratory will retain project files and data packages for a period not less than five years.

Laboratory Logbooks. Workbooks, bench sheets, instrument logbooks and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated QCs. As such, logbooks, bench sheets, instrument logs and instrument printouts will be part of the permanent record of the laboratory. Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with one stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions. Information regarding the sample, analytical procedures performed and results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, instrument used and instrument conditions. Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness and compliance

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with this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

Computer and Hard Copy Storage. All electronic files and deliverables will be retained by the laboratory for not less than six years; hard copy data packages (or electronic copies) will also be retained for not less than six years.

Field Data Reporting. Information collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the Task Manager for adherence to the associated plan and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible and (as necessary) incorporated into the data evaluation process. If applicable, field data forms and calculations will be processed and included in appendices to the appropriate reports (when generated). The original field logs documents and data reductions will be kept in the project files.

Laboratory Data Reporting. Data reports for all parameters will include, at a minimum, the discussed below.

Narrative: Summary of activities that took place during sample analysis including the following information:

- laboratory name and address;
- date of sample receipt;
- cross reference of laboratory identification number to contractor sample identification;
- analytical methods used;
- deviations from specified protocol; and
- corrective actions taken.

Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.

Analytical Results: These will be reported according to analysis type and include the following information, as applicable:

- sample ID;
- laboratory ID;
- date of collection;
- date of receipt;
- date of extraction;
- date of analysis; and
- method detection and reporting limits.

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Sample results on the report forms will be corrected for dilutions. Soil data, if any, will be reported on a dry weight basis. Unless otherwise specified, all results will be reported uncorrected for blank contamination. The analytical analysis will be performed using USEPA approved methodology. The VAP data will be reported as a Level 2 data package and the monitoring well groundwater data will be reported as Level 4.

Data reporting levels for VAP samples are as follows:

Level 2 — Modified Reporting: Modified reporting is used for analyses that are performed following standard USEPA-approved methods and QA/QC protocols. Based on the intended data use, modified reporting may require some supporting documentation, but not full CLP or CLP-type reporting.

Level 2 Laboratory data report required elements:

- Chain-of custody;
- Case Narrative;
- Final parameter concentration for all samples; soil concentrations reported as dry weight;
- Preparation or extraction and analysis dates/times;
- Method Blanks;
- Surrogate recoveries;
- Matrix Spike and Matrix Spike Duplicate recoveries and RPD;
- Laboratory Duplicate RPD;
- Laboratory Control Sample recoveries

Data reporting levels for monitoring well samples are as follows:

Level 4 - Full Reporting: Full "CLP-type" reporting is used for those analyses that, based on the intended data use, require full documentation. Level 4 Laboratory data report includes the elements for Level 2 listed above and the following:

- Calibrations (Initial & Continuing)
- Instrument blanks
- Gas Chromatograph/Mass Spectrometer Instrument Tuning
- Internal standard areas
- Serial dilution %D
- Primary/Secondary Column %D (GC)
- Raw data output for all field samples and associated QA/QC samples

Quality Assurance Project Plan Worksheet #14 – Summary of Project Tasks

Assessment/Audit Tasks

Performance and systems audits will be completed in the field and laboratory during the site investigations, as described below and in Worksheets #31 and #32.

1. ***Field Audits***. The following field performance and systems audits will be completed during this project.

   The Task Manager (or their designee), will monitor field performance. Field performance audit summaries will contain an evaluation of field activities to verify that the activities are performed according to established procedures as described in field sampling SOPs located in Appendix D of the Site Investigation Work Plan (SIWP). Field performance audits may also be performed by the appropriate Project Manager (or their designee). The auditor(s) will review field reports and communicate concerns to the Project Manager and/or Task Manager, as appropriate.

   The number and frequency of field performance audits conducted will be determined independently by the Project Manager and Task Manager. The observations made during field performance audits and any recommended changes/deviations to the field procedures will be recorded and documented.

   In addition, the appropriate Data QA Manager will review the rinse (if any) and trip blank data to identify potential deficiencies in field sampling and cleaning procedures. In addition, systems audits comparing scheduled QA/QC activities from this QAPP with actual QA/QC activities completed will be performed. The Task Manager and Data QA Manager will periodically confirm that work is being performed consistent with this QAPP.

2. **Laboratory Audits**

   Internal laboratory audits are conducted periodically by the Laboratory QA Manager. As part of the audit, the overall performance of the laboratory staff is evaluated and compared to the performance criteria outlined in the laboratory QA manual and SOPs. Results of the audits are summarized and issued to each department supervisor, Laboratory Manager and Laboratory Director. A systems audit of each laboratory is also performed by the Data QA Manager to determine whether the procedures implemented by each laboratory comply with the QA manual and SOPs.

   As a participant in state and federal certification programs, the laboratory is audited by representatives of the regulatory agency issuing certification, in addition to the laboratory's internal audits. Audits are usually conducted annually and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

   ARCADIS reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the project, as deemed necessary.

Quality Assurance Project Plan Worksheet #14 – Summary of Project Tasks

3. Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP. Corrective actions include procedures to promptly investigate, document, evaluate and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the actions are described below.

a. Field Procedures

If, during field work, a condition is noted by the field crew that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause and corrective action implemented by the Task Manager or a designee will be documented on a corrective action form and reported to the appropriate Project Manager and Data QA Manager.

Examples of situations that would require corrective actions are as follows:

- protocols as defined by the QAPP have not been followed;
- equipment is not in proper working order or is not properly calibrated;
- QC requirements have not been met; and
- issues resulting from performance or systems audits have not been resolved.

Project personnel will continuously monitor ongoing work performance as part of daily responsibilities.

b. Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause and corrective action taken will be documented and reported to the Project Manager and Data QA Manger.

Corrective action may be initiated, at a minimum, under the following conditions:

- protocols as defined by this QAPP have not been followed;
- predetermined data acceptance standards are not obtained;
- equipment is not in proper working order or calibrated;
- sample and test results are not completely traceable;
- QC requirements have not been met; and
- issues resulting from performance or systems audits have not been resolved.

Quality Assurance Project Plan Worksheet #14 – Summary of Project Tasks

Laboratory personnel will continuously monitor ongoing work performance as part of daily responsibilities. Corrective action will be initiated at the point where the problem has been identified. At whatever level this occurs (analyst, supervisor, data review, or quality control), it will be brought to the attention of the Laboratory QA Manager and, ultimately, the Laboratory Director. Final approval of any action deemed necessary is subject to the approval of the Laboratory Director. Any corrective action deemed necessary based on system or performance audits, the analytical results of split samples, or the results of data review will be implemented. The corrective action may include sample re-extraction, re-preparation, re-analysis, cleanup, dilution, matrix modification or other activities.
Data Review Tasks
See Worksheets #36 and #37.

QAPP Worksheet #15 Reference Limits and Evaluation (Groundwater)

Analyte	CAS Number	Screening Criteria[1]	Water Reference Limits	
			Laboratory Reporting Limit (RL)[2]	Laboratory Method Detection Limit (MDL)
Volatile Organic Compounds (SW-846 8260)[3] (micrograms per liter [ug/L])				
Dichlorodifluoromethane	75-71-8	1,400	1	0.20
Chloromethane	74-87-3	NS	1	0.18
Bromomethane	74-83-9	NS	1	0.31
Vinyl chloride	75-01-4	2	0.5	0.10
Chloroethane	75-00-3	NS	1	0.34
Trichlorofluoromethane	75-69-4	2,100	1	0.19
Methylene chloride	75-09-2	5	5	0.68
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NS	1	0.22
Acetone	67-64-1	6,300	5	1.29
Carbon disulfide	75-15-0	700	5	0.43
Methyl acetate	79-20-9	NS	2	0.53
1,1-Dichloroethene	75-35-4	7	1	0.31
1,1-Dichloroethane	75-34-3	1,400	1	0.19
trans-1,2-Dichloroethene	156-60-5	100	1	0.25
Methyl tert-butyl ether	1634-04-4	70	1	0.24
Chloroform	67-66-3	70	1	0.20
1,2-Dichloroethane	107-06-2	5	1	0.28
cis-1,2-Dichloroethene	156-59-2	70	1	0.12
2-Butanone (Methyl Ethyl Ketone)	78-93-3	4,200	5	1.47
1,1,1-Trichloroethane	71-55-6	200	1	0.20
Cyclohexane	110-82-7	NS	1	0.23
Carbon tetrachloride	56-23-5	5	1	0.26
Bromodichloromethane	75-27-4	NS	1	0.17
1,2-Dichloropropane	78-87-5	5	1	0.20
cis-1,3-Dichloropropene	10061-01-5	NS	1	0.18
Trichloroethene	79-01-6	5	0.5	0.19
Methylcyclohexane	108-87-2	NS	1	0.14
Dibromochloromethane	124-48-1	NS	1	0.32
1,2-Dibromoethane	106-93-4	0.05	1	0.36
1,1,2-Trichloroethane	79-00-5	5	1	0.28
Benzene	71-43-2	5	0.5	0.074
trans-1,3-Dichloropropene	10061-02-6	NS	1	0.21
Bromoform	75-25-2	NS	1	0.28
Isopropylbenzene	98-82-8	700	1	0.14
4-Methyl-2-pentanone	108-10-1	NS	5	0.33
2-Hexanone	591-78-6	NS	5	0.56
Tetrachloroethene	127-18-4	5	1	0.17
Toluene	108-88-3	1,000	0.5	0.11
1,1,2,2-Tetrachloroethane	79-34-5	NS	1	0.23
Chlorobenzene	108-90-7	100	1	0.14
Ethylbenzene	100-41-4	700	0.5	0.13
Styrene	100-42-5	100	1	0.10
Xylenes (Total)	1330-20-7	10,000	1	0.068
1,3-Dichlorobenzene	541-73-1	NS	1	0.15
1,4-Dichlorobenzene	106-46-7	75	1	0.15
1,2-Dichlorobenzene	95-50-1	600	1	0.27
1,2-Dibromo-3-chloropropane	96-12-8	0.2	2	0.87
1,2,4-Trichlorobenzene	120-82-1	70	1	0.31
Semivolatile Organic Compounds (SW-846 8270D)[3] (ug/L)				
Benzaldehyde	100-52-7	NS	16	12.1
Phenol	108-95-2	NS	4	0.537
2-Chlorophenol	95-57-8	NS	4	0.447
2-Methylphenol	95-48-7	350	1.6	0.244
2,2'-oxybis(1-Chloropropane)	108-60-1	NS	1.6	0.304
Acetophenone	98-86-2	NS	4	0.531
3&4-Methylphenol	15831-10-4	NS	1.6	0.359
N-Nitroso-di-n-propylamine	621-64-7	NS	0.4	0.123
Hexachloroethane	67-72-1	NS	4	0.479
Nitrobenzene	98-95-3	NS	0.8	0.359
Isophorone	78-59-1	NS	1.6	0.300
2-Nitrophenol	88-75-5	NS	8	2.00
2,4-Dimethylphenol	105-67-9	NS	8	1.44
bis(2-Chloroethoxy)methane	111-91-1	NS	1.6	0.227
2,4-Dichlorophenol	120-83-2	NS	8	2.08
Naphthalene	91-20-3	140	0.8	0.247
4-Chloroaniline	106-47-8	NS	8	1.61
Hexachlorobutadiene	87-68-3	NS	4	0.412
Caprolactam	105-60-2	NS	8	1.19
4-Chloro-3-methylphenol	59-50-7	NS	8	1.84
2-Methylnaphthalene	91-57-6	28	0.4	0.0521
Hexachlorocyclopentadiene	77-47-4	50	16	5.1
2,4,6-Trichlorophenol	88-06-2	NS	4	0.573
2,4,5-Trichlorophenol	95-95-4	NS	8	2.05
1,1'-Biphenyl	92-52-4	NS	4	0.29
2-Chloronaphthalene	91-58-7	NS	1.6	0.188

QAPP Worksheet #15 Reference Limits and Evaluation (Groundwater)

Analyte	CAS Number	Screening Criteria[1]	Water Reference Limits	
			Laboratory Reporting Limit (RL)[2]	Laboratory Method Detection Limit (MDL)
2-Nitroaniline	88-74-4	NS	4	1.03
Dimethylphthalate	131-11-3	NS	1.6	0.251
Acenaphthylene	208-96-8	NS	0.8	0.214
2,6-Dinitrotoluene	606-20-2	NS	0.4	0.059
3-Nitroaniline	99-09-2	NS	8	1.43
Acenaphthene	83-32-9	420	0.8	0.247
2,4-Dinitrophenol	51-28-5	NS	16	6.87
4-Nitrophenol	100-02-7	NS	16	5.94
Dibenzofuran	132-64-9	NS	1.6	0.21
2,4-Dinitrotoluene	121-14-2	NS	0.8	0.196
Diethylphthalate	84-66-2	5,600	1.6	0.289
4-Chlorophenyl-phenylether	7005-72-3	NS	4	0.508
Fluorene	86-73-7	280	0.8	0.195
4-Nitroaniline	100-01-6	NS	8	1.33
4,6-Dinitro-2-methylphenol	534-52-1	NS	16	4.72
N-Nitrosodiphenylamine	86-30-6	NS	0.8	0.296
4-Bromophenyl-phenylether	101-55-3	NS	4	0.432
Hexachlorobenzene	118-74-1	NS	0.4	0.0635
Atrazine	1912-24-9	3	4	0.5
Pentachlorophenol	87-86-5	1	16	3.15
Phenanthrene	85-01-8	NS	0.8	0.241
Anthracene	120-12-7	2,100	0.8	0.267
Carbazole	86-74-8	NS	4	0.283
Di-n-butyl phthalate	84-74-2	700	4	0.584
Fluoranthene	206-44-0	280	0.8	0.363
Pyrene	129-00-0	210	0.8	0.341
Butylbenzylphthalate	85-68-7	NS	1.6	0.384
3,3'-Dichlorobenzidine	91-94-1	NS	4	1.37
Benzo(a)anthracene	56-55-3	0.13	0.16	0.0453
Chrysene	218-01-9	12	0.4	0.0545
bis(2-Ethylhexyl)phthalate	117-81-7	NS	8	1.37
Di-n-octyl phthalate	117-84-0	NS	8	0.84
Benzo(b)fluoranthene	205-99-2	0.18	0.16	0.0645
Benzo(k)fluoranthene	207-08-9	0.17	0.16	0.0512
Benzo(a)pyrene	50-32-8	0.2	0.16	0.0791
Indeno(1,2,3-cd)pyrene	193-39-5	0.43	0.16	0.0598
Dibenz(a,h)anthracene	53-70-3	0.3	0.24	0.0406
Benzo(g,h,i)perylene	191-24-2	NS	0.8	0.300
Pesticides (SW-846 8081B)[3] (ug/L)				
alpha-BHC	319-84-6	0.11	0.04	0.0026
beta-BHC	319-85-7	NS	0.04	0.0102
delta-BHC	319-86-8	NS	0.04	0.0103
gamma-BHC	58-89-9	0.2	0.04	0.0056
Heptachlor	76-44-8	0.4	0.04	0.0135
Aldrin	309-00-2	NS	0.04	0.0053
Heptachlor epoxide	1024-57-3	0.2	0.04	0.0138
Endosulfan I	959-98-8	NS	0.04	0.0041
Dieldrin	60-57-1	NS	0.04	0.0129
4,4'-DDE	72-55-9	NS	0.04	0.0038
Endrin	72-20-8	2	0.04	0.0142
Endosulfan II	33213-65-9	NS	0.04	0.0028
4,4'-DDD	72-54-8	NS	0.04	0.0133
Endosulfan sulfate	1031-07-8	NS	0.04	0.0117
4,4'-DDT	50-29-3	NS	0.04	0.0032
Methoxychlor	72-74-5	40	0.08	0.023
Endrin ketone	53494-70-5	NS	0.04	0.017
Endrin aldehyde	7421-93-4	NS	0.04	0.0082
alpha-Chlordane	5103-71-9	2	0.04	0.0044
gamma-Chlordane	5103-74-2	2	0.04	0.0072
Toxaphene	8001-35-2	3	0.4	0.2
Polychlorinated Biphenyls (SW-846 8082A)[3] (ug/L)				
Aroclor 1016	12674-11-2	NS	0.4	0.067
Aroclor 1221	11104-28-2	NS	0.4	0.2
Aroclor 1232	11141-16-5	NS	0.4	0.2
Aroclor 1242	53469-21-9	NS	0.4	0.2
Aroclor 1248	12672-29-6	NS	0.4	0.2
Aroclor 1254	11097-69-1	NS	0.4	0.2
Aroclor 1260	11096-82-5	NS	0.4	0.07
Total PCBs	NA	0.5	--	--
Dissolved Gases (RSK-175)[4] (ug/L)				
Ethane	74-84-0	NS	1.1	0.55
Ethene	74-85-1	NS	1	0.5
Methane	74-82-8	NS	0.58	0.29
Metals (SW-846 6010B, 7470A)[3] (milligrams per liter [mg/L])				
Arsenic	7440-38-2	0.01	0.01	0.00306
Barium	7440-39-3	2	0.01	0.00224

QAPP Worksheet #15 Reference Limits and Evaluation (Groundwater)

Analyte	CAS Number	Screening Criteria[1]	Water Reference Limits	
			Laboratory Reporting Limit (RL)[2]	Laboratory Method Detection Limit (MDL)
Cadmium	7440-43-9	0.005	0.002	0.000939
Chromium	7440-47-3	0.1	0.01	0.00235
Lead	7439-92-1	0.0075	0.005	0.0024
Selenium	7782-49-2	0.05	0.01	0.00462
Silver	7440-22-4	0.05	0.005	0.00132
Mercury	7439-97-6	0.002	0.0002	0.0000611
Wet Chemistry (mg/L)				
Sulfate (SW-846 9038)[3]	14808-79-8	400	5	2
Sulfide (SW-846 9034)[3]	18496-25-8	NS	1	0.219
Total Suspended Solids (SM 2540D)[5]	NA	NS	5	1.6
Total Organic Carbon (SW-846 9060)[3]	7440-44-0	NS	1	0.23
Ammonia (SM 4500NH3_G)[5]	7664-41-7	NS	0.2	0.043

Abbreviations:
NA = not applicable
NS = not specified

Notes:
1. Groundwater screening criteria correspond to the Illinois Section 620.410 Groundwater Quality Standards for Class I: Potable Resource Groundwater. Shaded cells indicate that the screening criteria is less than the laboratory RL and/or MDL.
2. Concentrations detected less than the RL but greater than the MDL must be reported with the appropriate qualifier.
3. USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste SW-846 3rd ed.* Washington, DC. 1996.
4. RSKSOP-175, Sample Preparation and Calculations for Dissolved Gas Analysis in Water Samples Using a GC Headspace Equilibrium Technique, Revision 2, May 2004.
5. Standard Methods for the Analysis of Water and Wastewater, APHA

Quality Assurance Project Plan Worksheet #16 – Project Schedule/Timeline

Activities	Organization	Anticipated Date(s) of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
Begin Phase 1 Activities	ARCADIS	Immediately following EPA approval of RI/FS Work Plan and Supporting Plans	30 days after commencing Phase 1 Activities	No	NA
Complete Review of Initial Data; Begin Phase 2 Activities	ARCADIS	Following discussion with EPA regarding Phase 1 data	6 weeks after commencing Phase 2 Activities	No	NA
Complete review of data collected during Phase 2; begin Phase 3 activities	ARCADIS	Following discussion with EPA regarding Phase 2 data	8 weeks after commencing Phase 3 activities	Remedial Investigation Report	6 months after Phase 3 work

Quality Assurance Project Plan Worksheet #17 – Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Piezometer Installation

Piezometers will be used to determine the direction of groundwater flow at the site. They will be installed as follows:

- Five shallow downgradient piezometers along the eastern edge of the Site to increase resolution along the Site boundary with Indian Ridge Marsh;
- Four shallow upgradient piezometers along the western property boundary;
- Six deep piezometers (clustered with shallow piezometers) to provide information on vertical gradients and deeper hydrostratigraphic units; and
- Five piezometers in the west central portion of the Site.

HPT and VAP

Eleven HPT locations are proposed on the eastern boundary of the LCCS to fully characterize the site's interaction with the Indian Ridge Marsh. The other boundaries each have four or five locations as needed. The interior of the site has 4 HPT locations. The investigation is meant to be adaptive and responsive to data as it is collected. If data indicates more points are needed they will be added.

Groundwater Sampling

New groundwater wells will be installed in locations determined during the Phase 2 work. It is estimated that eight to twelve well pairs or clusters will be needed. The locations will be chosen as follows:

- Two to three wells will be installed at each location to allow for evaluation of vertical stratification of the aquifer and vertical hydraulic gradients;
- Wells will be screened in specific identified mass-bearing hydrostratigraphic units (HSUs), with screen lengths customized based on the thickness of the HSU to avoid potential communication between HSUs;
- Well clusters will be distributed laterally to provide reproducible monitoring locations that are adequate for evaluating the horizontal hydraulic gradient and groundwater flow direction; and
- A subset of the well clusters will be located along the upgradient portion of the Site to evaluate potential constituent contributions from off-site sources.

Quality Assurance Project Plan Worksheet #18 – Sampling Locations and Methods/Standard Operating Procedure Requirements

Sampling Location/ ID Number	Matrix	Sample Type and Number	Analytical Group	Concentration Level	Number of Samples (plus field duplicates)[1]	Sampling Standard Operating Procedure (SOP) Reference Number[2]	Rationale for Sampling Location
VAP points. See Figure 2 in the FSP	Groundwater	Adaptive[3]	VOCs, ammonia and dissolved metals	Low	Adaptive[3]	F-4	Additional data to improve the existing understanding of Site impacts and to support future selection and design of an appropriate remedial alternative.
Monitoring Wells	Groundwater	Adaptive[3]	Total compound list	Low	Adaptive[3]	F-6	Locations will be chosen in areas where further information is required to fully characterize the site.

Notes:

[1] One blind duplicate sample will be collected for every 10 samples.

[2] Sampling SOP reference number from QAPP Worksheet #21.

[3] The depth intervals and number of groundwater samples collected and analyzed from each VAP point will be determined in the field based on the number of permeable water-bearing zones identified during the HPT investigation. An estimated 5 samples will be collected at each location, but additional samples may be added, and sample depths adjusted, to characterize permeable zones. The number of monitoring wells (and thus the number of groundwater samples collected from monitoring wells) will be determined based on the results of the HPT and VAP investigations. Proposed monitoring well locations and construction details will be submitted to the USEPA for review prior to mobilizing for monitoring well installation.

Quality Assurance Project Plan Worksheet #19
Analytical Standard Operating Procedure Requirements (Sample Containers, Preservation and Holding Times)

Parameter	Analytical and Preparation Method/SOP Reference	Method	Bottle Type	Preservation	Holding Time [1]
Groundwater					
Volatile Organic Compounds	SW-846 8260B/L-1	8260B[2]	3 x 40-ml glass vial	HCl to pH<2, Cool to <6°C	14 days to analysis
Semi-Volatile Organic Compounds	SW-846 3510C and 8270D/L-2	3510C/8270D[2]	2 x 250 mL amber	none, cool to <6°C	7 days to extraction; 40 days to analysis
Pesticides	SW-846 3510C and 8081B/L-3	3510C/8081B[2]	2 x 250 mL amber	none, cool to <6°C	7 days to extraction; 40 days to analysis
PCBs	SW-846 3510C and 8082A/L-4	3510C/8082A[2]	2 x 250 mL amber	none, cool to <6°C	7 days to extraction; 40 days to analysis
Metals	SW-846 3010A and 6010B/L-5	3010A/6010B[2]	250 mL plastic	HNO3 to pH<2, Cool to <6°C	180 days to analysis
Mercury	SW-846 7470A/L-6	7470A[2]	250 mL plastic	HNO3 to pH<2, Cool to <6°C	28 days to analysis
Sulfate	SW-846 9038/L-8	9038 [2]	500 mL plastic	none, cool to <6°C	28 days to analysis
Sulfide	SW-846 9034/L-9	9034 [2]	500 mL plastic	none, cool to <6°C	7 days to analysis
Total Suspended Solids	SM 2540D/L-11	SM 2540D[3]	500 mL plastic	none, cool to <6°C	7 days to analysis
Dissolved Gases	RSK-175/L-7	RSK-175[4]	3 x 40-ml amber glass vial	HCl to pH<2, Cool to <6°C	14 days to analysis
Total Organic Carbon	SW-846 9060/L-10	9060A[2]	3 x 40-ml glass vial	H2SO4 to pH<2, cool to <6°C	28 days to analysis
Ammonia	SM 4500NH3_G/L-12	SM4500NH3_G[3]	500 mL plastic	H2SO4 to pH<2, cool to <6°C	28 days to analysis

Abbreviations:
°C = degree Celsius
ml = milliliter

Notes:
[1] All holding times are measured from date of collection.
[2] USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste SW-846.* 3rd ed. Update IV Washington, DC. 1996.

Quality Assurance Project Plan Worksheet #20 -
Sample Quantities and Control Frequencies

Matrix/Analysis	Analytical and Preparation SOP[1]	Estimated Environ. Sample Quantity[2]	Field QC Analyses				Laboratory QC Sample						Total
			Trip Blank		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Lab Duplicate		
			Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Groundwater													
VOCs	L-1	24	1/cooler	2	1/10	3	1/20	2	1/20	2	NA	--	33
Metals/ammonia	L-5, L-6, L-12	24	NA	--	1/10	3	1/20	2	1/20	2	1/20	2	33
All groundwater analyses	L-1 through L-12	adaptive	1/cooler	TBD	1/10	TBD	1/20	TBD	1/20	TBD	1/20	TBD	TBD

Abbreviations:

Freq. = frequency
NA = not applicable
QC = quality control
VOC=volatile organic compound

Notes:

[1]See Worksheet #23 for SOP title, revision number and date details.

[2]Sample quantities are approximate

Quality Assurance Project Plan Worksheet #21 – Field Sampling Standard Operating Procedure References

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Yes/No)	Comments
F-1	Chain-of-Custody, Handling, Packing and Shipping, Rev. #2, Rev Date: March 6, 2009	ARCADIS	See SOP for specific equipment needs	No	Describes field sample custody, handling, packaging and shipping procedures
F-2	Field Equipment Decontamination, Rev. #3, Rev Date: April 26, 2010	ARCADIS	See SOP for specific equipment needs	No	Describes the procedure for field equipment cleaning and decontamination
F-3	Water Level Measurement, Rev. #2, Rev Date: February 24, 2011	ARCADIS	See SOP for specific equipment needs	No	Describes the procedure for measuring and recording groundwater and surface-water elevations, and the required equipment
F-4	Procedures for Use of the Geoprobe Hydraulic Profiling Tool® (HPT), Rev #0 Date: February 2014	ARCADIS	See SOP for specific equipment needs	No	Describes the procedure for HPT and VAP
F-5	Monitoring Well Installation, Rev #3 Date: February 2, 2011	ARCADIS	See SOP for specific equipment needs	No	Describes procedure for installing new monitoring wells
F-6	Low Flow Groundwater Purging and Sampling for Monitoring Wells, Rev #4, Date: February 2, 2011	ARCADIS	See SOP for specific equipment needs	No	Describes procedure for groundwater monitoring

Note: The Field Sampling SOPs are located in Attachment 1 of the FSP.

Quality Assurance Project Plan Worksheet #22 – Field Equipment Calibration, Maintenance, Testing and Inspection

Field Equipment	Calibration Activity/ Frequency	Maintenance Activity	Testing Activity	Inspection Activity	Acceptance Criteria	Corrective Action	Responsible Person	Standard Operating Procedure Reference
Combination Water-Quality Meter	At least daily when used	As required by manufacturer specifications	Temperature, conductivity, pH, turbidity, dissolved oxygen, and oxidation-reduction potential	Check all membranes and sensors, cable, and battery charge	Per manufacturer specifications	Re-calibrate, troubleshoot according to manufacturer specifications, and replace instrument if necessary	Field personnel	Field Equipment Decontamination SOP

Note: The Field Sampling SOPs are located in the FSP.

Quality Assurance Project Plan Worksheet #23 – Analytical Standard Operating Procedure References

Standard Operating Procedure (SOP) Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
L-1	SOP-UP-MV-8260: Gas Chromatography Mass Spectrometry – Volatiles SW-846 Method 8260B; Rev 25; Date 11/28/14	Definitive	Volatile Organic Compounds (VOCs) in water	Gas Chromatography/ Mass Spectrometry (GC/MS)	TestAmerica	No
L-2	SOP-UP-MB-8270D: Gas Chromatography/Mass Spectrometry – Semi-Volatiles SW-846 Method 8270D; Rev 7; Date 5/15/2015 AND SOP-UP-SP-3510: Sample Preparation: Semivolatile and Nonvolatile Organic Compounds from a Wastewater or Leachate Matrix using Separatory Funnel Extraction; Rev 15; Date 6/19/2014	Definitive	Semi-volatile organic compounds (SVOCs) in water	GC/MS	TestAmerica	No
L-3	SOP-UP-GE-8081: Gas Chromatography – Semi-Volatiles, Pesticides by SW-846 Method 8081A and 8081B; Rev 17; Date 9/24/2014 AND SOP-UP-SP-3510: Sample Preparation: Semivolatile and Nonvolatile Organic Compounds from a Wastewater or Leachate Matrix using Separatory Funnel Extraction; Rev 15; Date 6/19/2014	Definitive	Pesticides in water	Gas Chromatography-Electron Capture Detector (GC-ECD)	TestAmerica	No

Quality Assurance Project Plan Worksheet #23 – Analytical Standard Operating Procedure References

Standard Operating Procedure (SOP) Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
L-4	SOP-UP-GE-8082: Gas Chromatography – Semi-Volatiles, Analysis of PCBs by SW-846 Method 8082 and 8082A; Rev 17; Date 9/26/2014 AND SOP-UP-SP-3510: Sample Preparation: Semivolatile and Nonvolatile Organic Compounds from a Wastewater or Leachate Matrix using Separatory Funnel Extraction; Rev 15; Date 6/19/2014	Definitive	PCBs in water	GC-ECD	TestAmerica	No
L-5	SOP-UP-ME-6010B: Metals Analysis Trace Inductively Coupled Argon Plasma by SW-846 6010B (Simultaneous Operation); Rev 7; Date 11/3/14 AND SOP-UP-SP-3000: Sample Preparation Metals Digestion by SW-846 3000 Series; Rev 25; Date 1/30/2015	Definitive	Metals in water	Inductively Couple Plasma-Atomic Emission Spectrometry (ICP-AES)	TestAmerica	No
L-6	SOP-UP-ME-245.1: Metals Analysis: Mercury by EPA Methods 245.1/245.5; SW-846 7470A/7471A/7471B; Rev 20; Date 6/12/14	Definitive	Mercury in water	Cold Vapor Atomic Absorption (CVAA)	TestAmerica	No
L-7	SOP-SA-VO-007: Dissolved Gases in Water; Rev 3; Date 11/29/2014	Definitive	Dissolved gases in water	Gas Chromatography/Flame Ionization Detector (GC/FID)	TestAmerica	No

Quality Assurance Project Plan Worksheet #23 – Analytical Standard Operating Procedure References

Standard Operating Procedure (SOP) Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
L-8	SOP-UP-WC-SO4: Turbidimetric Determination of Sulfate; Rev 18; Date 5/15/2015	Definitive	Sulfate in water	Spectrophotometer	TestAmerica	No
L-9	SOP-UP-WC-Sulfide: Total Acid Soluble, Acid-Volatile, and Reactive Sulfide; Rev 20A; Date 11/26/2014	Definitive	Sulfide in water	Titration	TestAmerica	No
L-10	SOP-UP-WC-TOC: Total Organic Carbon/Total Inorganic (Dissolved) Carbon; Rev 17; Date 4/30/2015	Definitive	Total organic carbon (TOC) in water	TOC Analyzer	TestAmerica	No
L-11	SOP-UP-WC-TSS: Total and Volatile Suspended Solids; Rev 18; Date 1/16/2015	Definitive	Total suspended solids (TSS) in water	Analytical balance	TestAmerica	No
L-12	SOP-UP-WC-NH3_AutoPhenate: Total and Unionized Ammonia Automated Phenate Method; Rev 3; Date 1/5/2015	Definitive	Ammonia in water	Autoanalyzer	TestAmerica	No

Quality Assurance Project Plan Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Gas Chromatography/ Mass Spectrometry (GC/MS) for Volatile Organic Compounds (SW-846 8260B) and Semi-Volatile Organic Compounds (SW-846 8270D)	Instrument performance check (tune).	Prior to initial and continuing calibration.	As per method.	Retune instrument.	Analyst	L-1, L-2
	Initial calibration — prior to sample analysis, a minimum of five concentration levels for all compounds.	Prior to sample analysis five points for all compounds. Yearly.	Each compound relative response factor (RRF) RSD ≤ 15% for all compounds or linear $r^2 \geq 0.99$ and RRF ≥ 0.05.	Inspect system, correct problem, rerun calibration and affected samples if RSD > 50% or linear $r^2 \geq 0.99$.		
	Continuing calibration — before sample analysis, one standard (midpoint).	Before sample analysis and every 12 hours.	Each compound percent difference ≤ 20% for all compounds or linear and response factor (RF) ≥0.05.	Inspect system, correct problem, rerun calibration and affected samples if %D > 80%.		
Gas Chromatography-Electron Capture Detector (GC-ECD) for Pesticides (SW-846 8081B)	Initial calibration — prior to sample analysis, a minimum of five concentration levels for all compounds.	After initial calibration, a check standard mixture is analyzed every 12-hour shift with the continuing calibration standard, which is analyzed after every 20 samples or end of sequence.	Each compound calibration factor (CF) ≤ 20% for all compounds or linear $r^2 \geq 0.99$.	Inspect system, correct problem, rerun calibration and affected samples if CF > 20% or linear $r^2 \geq 0.99$.	Analyst	L-3
	Continuing calibration — before sample analysis, one standard (midpoint).	Pesticide mixture is analyzed every 12-hour shift with the continuing calibration standard, which is analyzed after every 20 samples or end of sequence.	Each compound %D ≤ 15%.	Inspect system, correct problem, rerun calibration and affected samples if %D > 15%.		
GC-ECD for Polychlorinated Biphenyls (SW-846 8082A)	Six-point calibration of Aroclors 1016 and 1260 mixture in concentration range that brackets linear range of detector. All other Aroclors are quantitated based on one-point standard calibration.	After initial calibration, a check standard of Aroclor 1016/1260 mixture is analyzed every 12-hour shift with the continuing calibration standard, which is analyzed after every 20 samples or end of sequence.	Initial calibration relative standard deviation (RSD) for Aroclor 1016/1260 ≤ 20% or linear regression >0.99.	If routine maintenance does not return the instrument performance to meet the QC requirements, a new calibration must be performed.	Analyst	L-4

Quality Assurance Project Plan Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
	Continuing calibration — before sample analysis, one standard (midpoint).	Aroclor 1016/1260 mixture is analyzed every 12-hour shift with the continuing calibration standard, which is analyzed after every 20 samples or end of sequence.	Check standard or continuing calibration standard must not exceed a percent difference of ±15%.			
Gas Chromatography/Flame Ionization Detector (GC/FID) for Dissolved Gases (RSK-175)	Initial calibration — prior to sample analysis, a minimum of 5 concentration levels for all compounds.	Prior to initial and continuing calibration.	Each compound Calibration Factor (CF) ≤ 20% for all compounds or linear $r^2 \geq 0.99$.	Inspect system, correct problem, rerun calibration and affected samples if CF > 50% or linear $r^2 \geq$ 0.99.	Analyst	L-7
	Continuing calibration — before sample analysis, 1 standard (midpoint).	Prior to sample analysis, 5 points for all compounds.	Each compound percent difference ≤ 20%.	Inspect system, correct problem, rerun calibration and affected samples if %D> 80%.		
Inductively Couple Plasma-Atomic Emission Spectrometry (ICP-AES) for Metals (SW-846 6010B)	Minimum two calibration standards and calibration blank, one standard (midpoint).	Daily/continuing.	Initial calibration — coefficient of variation ≥ 0.995. Continuing calibration — +/- 10% difference. Low-level check (CRI) continuing calibration — +/- 30% difference.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	L-5
Cold Vapor Atomic Absorption (CVAA) for Mercury (SW-846 7470A)	Initial calibration — five concentration levels. Continuing calibration — one standard.	Daily, or on continuing calibration failure. Continuing, every 10 samples.	Initial calibration - ≥ 0.995 coefficient of variation. Continuing calibration — +/- 20% difference.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	L-6

Quality Assurance Project Plan Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
			Low-level check (CRI) continuing calibration — +/- 30% difference.			
Autoanalyzer Spectrophotometer TOC Analyzer	Initial calibration — six concentration levels. Continuing calibration — one standard.	Daily, or on continuing calibration failure. Continuing, every 10 samples.	Initial calibration — coefficient of variation ≥ 0.995. Continuing calibration — +/- 10% difference.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	L-8, L-10, L-12

Note: [1]SOP reference numbers correspond to the analytical SOPs in Worksheet #23.

Quality Assurance Project Plan Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Gas Chromatography/Mass Spectrometry (GC/MS)	• Replace pump oil as needed • Change gas line dryers as needed • Perform ion source cleaning and filament replacement • Replace injection port liner weekly or as needed • Clip column • Replace gas chromatography (GC) column as needed • Manual tuning • Replace electron multiplier • Check that gas supply is sufficient and delivery pressure is adequate • Bake out lines and column	Volatile Organic Compounds and Semi-Volatile Organic Compounds	Check connections, bake out instrument, leak test	See L-1 and L-2	See L-1 and L-2	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-1 and L-2
Gas Chromatography/ Electron Capture Detector (GC/ECD) and Gas Chromatography/Flame Ionization Detector (GD/FID)	• Change septa weekly or as needed • Change gas line dryers as needed • Replace injection port liner weekly or as needed • Clip column • Replace GC column as needed • Clean/replace detector as needed • Check that gas supply is sufficient and delivery pressure is adequate	Pesticides, Polychlorinated Biphenyls, and Dissolved Gases	Check connections, bake out instrument, leak test	See L-3, L-4, and L-7	See L-3, L-4, and L-7	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-3, L-4, and L-7

Quality Assurance Project Plan Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES)	• change capillary and pump tubing • check liquid argon tank • replace and realign plasma torch clean nebulizer and spray chamber	Metals	Check connections, replace worn equipment	See L-5	See L-5	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-5
Cold Vapor Atomic Absorption (CVAA)	• clean tubing and quartz cell as needed • clean aspirator as necessary • check level of mercury scrubber solution • replace lamps provide that gas supply is sufficient and delivery pressures are adequate	Mercury	Check connections, replace worn equipment	See L-6	See L-6	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-6
TOC analyzer	• Inspect tubing, copper/tin scrubber, and autosampler syringe	Total organic carbon	Check connections, replace worn equipment	See L-10	See L-10	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-10
Spectrophotometer	• Calibration	Sulfate	Check connections, replace worn equipment	See L-8	See L-8	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-8
Autoanalyzer	• Change tubing • Change O-ring • Flush lines at end of each run	Ammonia	Check connections, replace worn equipment	See L-12	See L-12	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-12
Balance	• Professional Service Contract	All	NA	1 time/year	NA	NA	Service Contractor	NA

Note: [1]SOP reference numbers correspond to analytical SOPs in Worksheet #23.

Quality Assurance Project Plan Worksheet #26 – Sample Handling System

Sample Collection, Packaging and Shipment
Sample Collection (Personnel/Organization): Field Personnel/ARCADIS
Sample Packaging (Personnel/Organization): Field Personnel/ARCADIS
Coordination of Shipment (Personnel/Organization): Field Personnel/ARCADIS
Type of Shipment/Carrier: Hand Delivery or Federal Express to TestAmerica
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): Sample Custodian/TestAmerica
Sample Custody and Storage (Personnel/Organization): Sample Custodian/TestAmerica
Sample Preparation (Personnel/Organization): Lab Analyst/ TestAmerica
Sample Determinative Analysis (Personnel/Organization): Lab Analyst/ TestAmerica
Sample Archiving
Field Sample Storage: Samples will be hand delivered or shipped at on the same day as sample collection.
Sample Extract/Digestate Storage (number of days from extraction/digestion): 60 days
Sample Disposal
Personnel/Organization: Lab Project Manager/Sample Custodian/ TestAmerica
Number of Days from Analysis: 30 days minimum from submittal of laboratory final report

Note: The personnel performing each task will be determined by the laboratory. The laboratory Project Manager will be responsible for ensuring the tasks are completed.

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

Sample Handling and Custody Requirements

At all times, field and laboratory personnel will be aware of the need to maintain all samples, whether in the field or in the laboratory, under strict chain-of-custody and in a manner to retain physical properties and chemical composition. This Worksheet details sample handling and custody requirements from collection to ultimate disposition.

Sample Handling (Sample Packaging, Shipping Containers and Sample Shipment, Sample Custody)

Sample packaging and shipment procedures are designed so that the samples will arrive at the laboratory, with the chain-of-custody, intact.

Samples will be packaged for shipment as outlined below.

- Securely affix the sample label to the container with clear packing tape.
- Check the cap on the sample container to confirm that it is properly sealed.
- Wrap the sample container cap with clear packing tape to prevent the label from becoming loose.
- Complete the chain-of-custody form with the required sampling information and confirm that the recorded information matches the sample labels. **Note:** If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place chain-of-custody forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the shipping address and return address, affix "Fragile" labels and draw (or affix) arrows indicating "this

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

side up." Cover the labels with clear plastic tape.

- Place a signed custody seal over the sample cooler lid.

Samples will be packaged by field personnel and transported as low-concentration environmental samples. Samples will be hand delivered or delivered by an express carrier within 24 hours of the time of collection. Shipments will be accompanied by the chain-of-custody form identifying the contents.

Sample Handling (Sample Packaging, Shipping Containers and Sample Shipment, Sample Custody) (continued)

The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the chain-of-custody form as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

Field Custody Procedures

The objective of field sample custody is to protect samples from tampering from the time of sample collection through time of transport to the analytical laboratory. Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field chain-of-custody forms.

Field logbooks will provide the means of recording the data collecting activities that are performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned;
- logbook number;

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

- project name;
- project start date; and
- end date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather conditions, names of all sampling team members present, level of personal protection being used and signature of the person making the entry will be provided. The names of visitors to the site and field sampling or investigation team personnel, as well as the purpose of their visit, will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Entries will be made in ink, with no erasures. If an incorrect entry is made, the information will be crossed out with one strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station will be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the field sampling SOPs located in Appendix D of the SIWP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

Sample Labels

Sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required on each sample label:

- project name;
- date collected;
- time collected;
- location;
- name of sampler;
- analysis to be performed;
- preservative; and
- sample ID.

Quality Assurance Project Plan Worksheet #27 – Sample Custody Requirements

Chain-of-Custody Record

Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be initiated by the sampling crew in the field. The chain-of-custody forms will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any) and analyses required. The original chain-of-custody form will accompany the samples to the laboratory. Copies of the chain-of-custody will be made prior to shipment (or multiple copy forms will be used) for field documentation. The chain-of-custody forms will remain with the samples at all times. The samples and signed chain-of-custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express), hand delivered to the laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink. The labels will include the information listed in the previous section (Sample Labels). The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are split with a government agency or other party, a separate chain-of-custody will be prepared for those samples and marked to identify the party with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, note this in the "Received By" space.

Laboratory Custody Procedures

Samples will be hand delivered on the same day as sample collection. According to the 2003 National Environmental Laboratory Accreditation Conference Standard, samples that are hand delivered to the laboratory on the same day are considered acceptable if there is evidence that the chilling process has begun such as arrival on ice. Therefore, upon receipt, laboratory personnel will confirm that the chilling process has begun and once accepted , laboratory personnel will be responsible for sample custody. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

Immediately upon sample receipt, the laboratory sample custodian will verify the integrity of the cooler seal, open the cooler and compare the contents against the field chain-of-custody. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, the ARCADIS Project Manager or Field Leader must be notified. The laboratory sample custodian, or designee, will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

Quality Assurance Project Plan Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds [VOCs] in Water, 8260B)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8260B/L-1	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-4, F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Surrogates	Three per sample	Laboratory-generated limits	Reanalyze sample	Lab personnel	Accuracy/bias	Laboratory-generated limits
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalyze batch	Lab personnel	Accuracy/bias contamination	< RL
Trip blanks	One per cooler containing VOC samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL

Quality Assurance Project Plan Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds [VOCs] in Water, 8260B)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8260B/L-1	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-4, F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per batch	Laboratory-generated limits	Qualify data as needed or reanalyze batch	Lab personnel	Precision	Laboratory-generated limits
Instrument check: Bromofluorobenzene (BFB)	One per calibration	% Relative abundance	Reanalyze batch	Lab personnel	Accuracy/bias	% Relative abundance
Internal standard	At least three per sample	Area response and retention times, see analytical SOP	Reanalyze sample	Lab personnel	Precision	Area response and retention times, see analytical SOP
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	Laboratory-generated limits
MS/MSD and LCS/LCS[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Precision	Laboratory-generated limits

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-2 – Quality Control Samples (Semi-Volatile Organic Compounds [SVOCs] in Water, 8270D)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8270D/L-2	**No. of Sample Locations**	Numerous	
Analytical Group	SVOCs	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Surrogates	Six per sample	Laboratory-generated limits	Reanalyze sample	Lab personnel	Accuracy/bias	Laboratory-generated limits
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalyze batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per analytical batch	Laboratory-generated limits	Qualify data as needed or reanalyze batch	Lab personnel	Accuracy/bias	Laboratory-generated limits

Quality Assurance Project Plan Worksheet #28-2 – Quality Control Samples (Semi-Volatile Organic Compounds [SVOCs] in Water, 8270D)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8270D/L-2	**No. of Sample Locations**	Numerous	
Analytical Group	SVOCs	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Instrument check: decafluorotri-phenylphosphine (DFTPP)	One per calibration	% Relative abundance, see analytical SOP	Reanalyze batch	Lab personnel	Accuracy/bias	% Relative abundance, see analytical SOP
Internal standard	At least six per sample	Area response and retention times, see analytical SOP	Reanalyze sample	Lab personnel	Precision	Area response and retention times, see analytical SOP
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	Laboratory-generated limits
MS/MSD and LCS/LCSD[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Precision	Laboratory-generated limits

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-3 – Quality Control Samples (Pesticides in Water, 8081B)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8081B/L-3	**No. of Sample Locations**	Numerous	
Analytical Group	Pesticides	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision — overall	RPD < 35%
Surrogates	Two per sample	Laboratory-generated limits	Reanalysis or reextraction/ reanalysis of sample	Lab personnel	Accuracy/bias	Laboratory-generated limits
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reextraction/ reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per analytical batch	Laboratory-generated limits	Reanalysis or reextraction/ reanalysis of batch	Lab personnel	Accuracy/bias	Laboratory-generated limits
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	Laboratory-generated limits

Quality Assurance Project Plan Worksheet #28-3 – Quality Control Samples (Pesticides in Water, 8081B)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8081B/L-3	**No. of Sample Locations**	Numerous	
Analytical Group	Pesticides	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
MS/MSD and LCS/LCSD[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Precision	Laboratory-generated limits

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-4 – Quality Control Samples (Polychlorinated Biphenyls [PCBs] in Water, 8082A)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8082A/L-4	**No. of Sample Locations**	Numerous	
Analytical Group	PCBs	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Surrogates	Two per sample	Laboratory-generated limits	Reanalysis or reextraction/ reanalysis of sample	Lab personnel	Accuracy/bias	Laboratory-generated limits
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reextraction/ reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per analytical batch	Laboratory-generated limits	Reanalysis or reextraction/ reanalysis of batch	Lab personnel	Accuracy/bias	Laboratory-generated limits
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	Laboratory-generated limits

Quality Assurance Project Plan Worksheet #28-4 – Quality Control Samples (Polychlorinated Biphenyls [PCBs] in Water, 8082A)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 8082A/L-4	**No. of Sample Locations**	Numerous	
Analytical Group	PCBs	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
MS/MSD and LCS/LCSD[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Precision	Laboratory-generated limits

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/ MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-5 – Quality Control Samples (Metals in Water, 6010B/7470A)

Matrix	Water	**Analytical Method/ SOP Reference**	SW-846 6010B/7470A L-5, L-6	**No. of Sample Locations**	Numerous	
Analytical Group	Metals	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-4, F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Method blanks	Numerous	< Reporting limit (RL)	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Calibration verification standards	Numerous	Percent recovery (%R): 90-110%; mercury (Hg) %R: 80-120%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 90-110%; Hg %R: 80-120%
Reporting limit standard (CRI)	Two per run	%R: 70-130% antimony/arsenic/ cobalt/thallium (Sb/As/Co/Tl) %R: 50-150%	Qualify data as needed or reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 70-130% Sb/As/Co/Tl %R: 50-150%
Interference check sample (A and AB)	Two per run	%R: 80-120%	Qualify data as needed or reanalysis of batch	Lab personnel	Precision – lab	%R: 80-120%

Quality Assurance Project Plan Worksheet #28-5 – Quality Control Samples (Metals in Water, 6010B/7470A)

Matrix	Water	**Analytical Method/ SOP Reference**	SW-846 6010B/7470A L-5, L-6	**No. of Sample Locations**	Numerous	
Analytical Group	Metals	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-4, F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per batch	%R: 80-120%	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias	%R: 80-120%
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	%R: 75-125%	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: 75-125%
MS/MSD and LCS/LCSD[2]	One per batch	RPD < 20%	Qualify data as needed	Lab and/or Data Validator	Precision – overall	RPD < 20%
Post-digestion spike	One per batch	%R: 75-125%	Qualify data as needed	Lab personnel	Accuracy/bias	%R: 75-125%
Serial dilution	One per batch	Percent difference (%D): < 10%	Qualify data as needed	Lab personnel	Precision	%D: < 10%

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/ MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-6 – Quality Control Samples (Dissolved Gases in Water, RSK-175)

Matrix	Water	**Analytical Method/ SOP Reference**	RSK-175/L-7	**No. of Sample Locations**	Numerous	
Analytical Group	Dissolved gases	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reextraction/ reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per analytical batch	Laboratory-generated limits	Reanalysis or reextraction/ reanalysis of batch	Lab personnel	Accuracy/bias	Laboratory-generated limits
Matrix spike (MS)/matrix spike duplicate (MSD)[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	Laboratory-generated limits
MS/MSD and LCS/LCSD[2]	One per batch	Laboratory-generated limits	Qualify data as needed	Lab and/or Data Validator	Precision	Laboratory-generated limits

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/ MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-7 – Quality Control Samples (Wet Chemistry, Water Quality)

Matrix	Water	**Analytical Method/ SOP Reference**	SW846 9038/L-8 SW846 9034/L-9 SM2540D/L-11 SW845 9060/L-10 SM4500NH3_G/L-12	**No. of Sample Locations**	Numerous	
Analytical Group	Wet Chemistry	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	F-4, F-6	**Analytical Organization**	TestAmerica			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**
Field duplicate	One per 20 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Method blanks	One per analytical batch	< Reporting limit (RL)	Qualify data as needed or reanalysis of batch	Lab and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Calibration verification standards (if applicable)	Numerous	Percent recovery (%R): 90-110%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R: 90-110%
Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD)[2]	One per analytical batch	%R: 80-120%	Reanalysis of batch	Lab personnel	Accuracy/bias	%R: 80-120%
Matrix spike (MS)/matrix spike duplicate (MSD)[2] (if possible)[2]	One per 20 field samples of similar matrix	%R: 75-125%	Qualify data as needed	Lab and/or Data Validator	Accuracy/bias	%R: 75-125%
Laboratory duplicate, MS/MSD, and LCS/LCSD	One per 20 field samples of similar matrix	RPD <20%	Qualify data as needed	Data Validator	Precision – overall	RPD <20%

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/ MSD and laboratory duplicate are not client-supplied.

Quality Assurance Project Plan Worksheet #29 – Project Documents and Records

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
- Field Notes - Sampling Logs - Chain-of-Custody Records - Air Bills - Custody Seals	- Equipment Calibration Logs - Field Data Records - Field Instrument Maintenance Logs	- Sample Receipt, Custody and Tracking Records - Standard Traceability Logs - Equipment Calibration Logs - Sample Prep Logs - Run Logs - Equipment Maintenance, Testing and Inspection Logs - Corrective Action Forms - Reported Field Sample Results - Reported Results for Standards, Quality Control (QC) Checks and QC Samples - Instrument Printouts (raw data) for Field Samples, Standards, QC Checks and QC Samples - Data Package Completeness Checklists - Sample Disposal Records - Extraction/Cleanup Records) - Raw Data (stored on disk or CD-R) - Analytical Reports to ARCADIS	- Data Validation Reports (if any) - Data Quality Assessments	- Health and Safety Plan - Quality Assurance Project Plan - Project Database - Electronic Data Deliverables (EDDs)

Note: Records and logs from the project will be stored in ARCADIS' Chicago, Illinois office.

Quality Assurance Project Plan Worksheet #30 – Analytical Services

Matrix	Analytical Group	Concentration Level	Analytical SOP	Data Package Turnaround Time (calendar days)	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory/Organization (name and address, contact person and telephone number)
Groundwater	All analytical groups previously mentioned	All	See Worksheet #23	21 days for Level 2/Level 4 Data Package	TestAmerica 2417 Bond Street University Park, IL 60484 708-534-5200	NA

Quality Assurance Project Plan Worksheet #31 – Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CAs) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Field Audit	Once during the activities described in the Site Investigation Work Plan	Internal	ARCADIS	Andy Pennington (or designee), Task Manager, ARCADIS	Jack Kratzmeyer Project Manager, ARCADIS	Andy Pennington, Task Manager , Jack Kratzmeyer Project Manager, ARCADIS	Andy Pennington, Task Manager, ARCADIS
Laboratory Audit of TestAmerica	Per Laboratory Quality Assurance Program	Internal	TestAmerica	Laboratory QA Manager	Laboratory Director	Laboratory QA Manager and Project Manager	Todd Church Data QA Manager, ARCADIS
Field Inspections	As-needed during work	Internal	ARCADIS	Andy Pennington (or designee), Task Manager, ARCADIS	Jack Kratzmeyer Project Manager, ARCADIS	Andy Pennington, Task Manager , Jack Kratzmeyer Project Manager, ARCADIS	Andy Pennington, Task Manager, ARCADIS

Quality Assurance Project Plan Worksheet #31 – Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CAs) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Safety Audits	Once during the activities described in the Site Investigation Work Plan	Internal	ARCADIS	Matt Anderson Health & Safety Manager, ARCADIS	Andy Pennington, Field QA Manager, Jack Kratzmeyer Project Manager, ARCADIS	Andy Pennington, Task Manager , Jack Kratzmeyer Project Manager, ARCADIS	Matt Anderson Health & Safety Manager, ARCADIS

Quality Assurance Project Plan Worksheet #32 – Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Field Sampling Technical Systems Audit	Written Audit Report	Jack Kratzmeyer Project Manager, ARCADIS	3 days after audit	Memorandum	Andy Pennington, Task Manager	2 days after notification
Laboratory Technical Audit (external)	Written Audit Report	TestAmerica PM, Jack Kratzmeyer (ARCADIS Project Manager) and Todd Church (ARCADIS Data QA Manager)	1 week after audit	Memorandum	TestAmerica QA Manager	2 days after notification
Field Inspection	Memorandum or verbal report of findings	Jack Kratzmeyer Project Manager, ARCADIS	2 days after inspection	Memorandum	Andy Pennington, Task Manager	2 days after notification
Laboratory Technical Audit (internal)	Memorandum or verbal report of findings	TestAmerica PM, Jack Kratzmeyer (ARCADIS Project Manager) and Todd Church (ARCADIS Data QA Manager)	2 days after audit	Memorandum	TestAmerica QA Manager	2 days after notification

Note: USEPA will be notified by email of findings that requires a corrective action.

Quality Assurance Project Plan Worksheet #33 – Quality Assurance Management Reports

Type of Report	Frequency (e.g., daily, weekly monthly, quarterly, annually)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Field Sampling Technical Systems Audit Report	As necessary during project	NA	Andy Pennington, Task Manager, ARCADIS	Jack Kratzmeyer Project Manager, ARCADIS
Laboratory Technical Audit Report	As necessary during project	NA	Todd Church Data QA Manager, ARCADIS	Jack Kratzmeyer Project Manager, ARCADIS
Data Validation Reports (if completed)	Data packages will be filed in the Project File and validated when necessary.	As generated throughout project	Todd Church Data QA Manager, ARCADIS	Jack Kratzmeyer Project Manager, ARCADIS
Data Quality Summary Reports	As appropriate for data use and as required for report completion	As generated throughout project	Todd Church Data QA Manager, ARCADIS	Jack Kratzmeyer Project Manager, ARCADIS

Note: USEPA will be notified by email of findings that requires a corrective action.

Quality Assurance Project Plan Worksheet #34 – Verification (Step I) Process

Verification Input	Description	Internal/ External	Responsible for Verification (name, title, organization)
Chain-of-custody and shipping forms	Chain-of-custody forms and shipping documentation will be reviewed by the laboratory upon receipt of samples for verification against the sample coolers they represent. Chain-of-custody forms will be signed by all parties that had custody of samples, with the exception of commercial carriers.	External	Bonnie Stadelmann Laboratory Project Manager, TestAmerica
Field notes and sampling logs	All field notes and sampling logs will be reviewed internally and placed in the project file.	Internal	Andy Pennington, Task Manager, ARCADIS
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	Laboratory QA Manager, TestAmerica
Laboratory data	All final data packages will be verified for content upon receipt.	External	Andy Pennington, Task Manager, Todd Church, Data QA Manager, ARCADIS

Quality Assurance Project Plan Worksheet #35 – Validation (Steps IIa and IIb) Process

Steps IIa and IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
Step IIa	Sampling methods and procedures	Establish that required sampling methods were used and that any deviations were noted. Provide that the sampling procedures and field measurements met performance criteria and that any deviations were documented.	Andy Pennington, Task Manager, ARCADIS
Step IIa	Analytical method and procedures	Establish that required analytical methods were used and that any deviations were noted. The laboratory will provide that QC samples met performance criteria and that any deviations were documented in the report narrative.	Bonnie Stadelmann TestAmerica Todd Church, Data QA Manager, ARCADIS
Step IIa Modified	Analytical method and procedures	Review associated blanks for potential contamination and verify that all preparations and analyses have been performed within applicable holding times.	Todd Church, Data QA Manager, ARCADIS
Step IIb	Documentation of Quality Assurance Project Plan (QAPP) QC sample results	Establish that all QAPP-required QC samples were collected and analyzed.	Todd Church, Data QA Manager, ARCADIS
Step IIb	Project quantitation limits	Determine that the project quantitation limits were achieved, as outlined in the QAPP.	Todd Church, Data QA Manager, ARCADIS

Quality Assurance Project Plan Worksheet #35 – Validation (Steps IIa and IIb) Process

Steps IIa and IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
Step IIb	Performance criteria	Evaluate QC data associated with the samples designated for intended uses stated in Worksheet #36 against project-specific performance criteria in the QAPP, laboratory QA manual and control criteria.	Todd Church, Data QA Manager, ARCADIS
Step IIb	Validation report (if any)	Summarize data verification and validation components included in the performance review. Include qualified data and explanation of all qualifiers.	Todd Church, Data QA Manager, ARCADIS

NOTE:

Quality Assurance Project Plan Worksheet #36 – Validation (Steps IIa and IIb) Summary

Steps IIa and IIb	Matrix	Analytical Group	Data Purpose	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa and IIb	Groundwater	VOCs, metals and ammonia	Site Investigation; Data Gap	Low, medium, high	If validation is performed, the following will be the Validation Criteria. United States Environmental Protection Agency (USEPA) *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999 and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, October 2004 applicable for SW-846 Methods will be used as guidance only, method criteria; laboratory control limits; Quality Assurance Project Plan (QAPP) criteria; and professional judgment	Todd Church, Data QA Manager, ARCADIS

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

The Data Usability Assessment will be performed by ARCADIS for data associated with the Former ECI Refinery Site. The Data Usability Assessment will be performed as described in this Worksheet. If data validation is done, documentation generated will include data validation reports with a brief summary of overall data usability.

The Data Usability Assessment process involves data verification and validation. Data verification is the process by which laboratory results are checked to provide that the proper quality control (QC) steps were performed and key items have met QC objectives (both analytical and contractual). Key steps of an ARCADIS data verification include the following:

- identifying sample collection, handling and analysis procedures;
- documenting handling and analysis activities (e.g., QC checklist);
- verifying (internally, at the data generator level) all sampling and handling;
- verifying laboratory data (e.g., laboratory-qualified data);
- verifying data package deliverable completeness;
- reviewing the case narrative;
- presenting all analytical results;
- summarizing QC sample data; and
- evaluating applicable raw data (if provided).

All required data deliverables must be present in the data package in order to proceed to the next step of data validation.

If done, data validation entails a review of the sample collection, handling, QC data, and the raw data to verify that the laboratory was operating within required limits, analytical results were correctly transcribed from the instrument read-outs, and which (if any) environmental samples were related to out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

The data quality indicators (DQIs) used to evaluate conformance with the project data quality objectives (DQOs) are presented below.

DQIs are generally defined in terms of six parameters listed below.

1. representativeness
2. comparability
3. completeness
4. precision
5. accuracy
6. sensitivity

Each parameter is defined below. Specific objectives for the site actions are presented in other sections of this QAPP, as referenced below.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. The QAPP presents the rationale for sample quantities and location. This QAPP presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP,

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

established quality assurance/quality control (QA/QC) procedures, and use of appropriately trained personnel.

Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the QAPP. Checks for analytical precision will include the analysis of matrix spike/matrix spike duplicates (MS/MSDs), laboratory duplicates, and field duplicates. Checks for field measurement precision will include duplicate field measurements.

The precision of data will be measured by calculating the Relative Percent Difference (RPD) by the following equation:

$$\text{RPD} = \frac{(A-B)}{(A+B)/2} \times 100$$

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Where:

A = Analytical result from one of two duplicate measurements.
B = Analytical result from the second measurement.

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, MSs, blank spikes and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard.
X = Value measured in original sample.
B = True value of amount added to sample or true value of standard.

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated method detection limits (MDLs) can satisfy the project requirements as they relate to the project action limits. MDLs are updated annually by the laboratory. The current MDLs for the analytical laboratories are presented in Worksheet #15.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Data Validation and Usability

If validation is done, ARCADIS will validate data generated using the United States Environmental Protection Agency's (USEPA's) National Functional Guidelines (Organics October 1999, Inorganics October 2004) as guidance for data validation. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits and procedures. Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs.

If done, the data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Any deviations from the analytical method or any special reporting requirements apart from those specified in this QAPP will be detailed on chain-of-custody (COC) forms.

If validation is done, the data validator will execute the procedures listed below.

- Evaluate completeness of data package.
- Verify that field COC forms were completed and that samples were handled properly.
- Verify that holding times were met for each parameter. Holding time exceedances, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis.
- Verify that parameters were analyzed according to the methods specified.
- Review QA/QC data (i.e., confirm that duplicates, blanks and spikes were analyzed on the required number of samples, as specified in the method and verify that duplicate and MS recoveries are acceptable).
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the ARCADIS Project Manager and/or Laboratory Manager, as appropriate.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

- If data appear suspect, investigate the specific data of concern. Calculations will be traced back to raw data. If calculations do not agree, the cause will be determined and corrected.

If validation is done, deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics, as applicable to each method:

- assessment of the data package;
- description of any protocol deviations;
- failures to reconcile reported and/or raw data;
- assessment of any compromised data;
- overall appraisal of the analytical data; and
- table of site name, sample quantities, matrix and fractions analyzed.

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean that data must be produced without QC qualifiers. Qualified data can provide useful information.

If validation is done, during the review process, laboratory qualified and unqualified data are verified against the supporting documentation. Based on this evaluation, qualifier codes may be added, deleted, or modified by the data reviewer. Results will be qualified with the codes listed below in accordance with the USEPA National Functional Guidelines.

Concentration (C) qualifiers:

U The analyte/compound was analyzed for, but not detected. The associated value is the compound quantitation limit.

J The reported value was obtained from a reading less than the required reporting limit (RL), but greater than or equal to the method detection limit.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Quantitation (Q) qualifiers:

Inorganics:

E The reported value is estimated due to the presence of interference.

N Spiked sample recovery not within control limits.

* Duplicate analysis not within control limits.

Organics:

B The compound has been found in the sample as well as its associated blank; its presence in the sample may be suspect.

N The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification.

P The lower of the two values is reported when the percent difference between the results of two gas chromatography (GC) columns is greater than 40 percent.

E The compound was quantitated above the calibration range.

D Concentration is based on a diluted sample analysis.

C Identification confirmed by gas chromatography/mass spectrometry (GC/MS).

If done, validation qualifiers:

UB The analyte/compound was analyzed for, but not detected. The associated value is the compound quantitation limit.

UJ The compound was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

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J The compound was positively identified; however, the associated numerical value is an estimated concentration only.

NJ The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.

X This qualifier will be further defined in the validation report and associated data. This qualifier will be used to define any data that may only be used for screening purposes (nondefinitive data) if the QA/QC deviation warrants the qualification of the data beyond estimation, but not rejection of the data.

R The sample results are rejected.

Two facts will be noted to all data users. First, the "R" flag means that the associated value is unusable. In other words, due to significant QC problems, the analysis is invalid and provides no information as to whether the compound is present or not. Analytes with "R" values should not appear on data tables because they cannot be relied upon for any reason. The second fact is that no compound concentration, even if it has passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

If validation is done, resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the ARCADIS Data QA Manager at this point.

Validation Reports (If validation is done)

If done, the data validation reports will identify all deficiencies and the potential impact on the results. The ARCADIS Data QA Manager or designee will amend qualifiers generated during the validation process to the database. The validation checklists and the database will be the primary location of all applicable data qualifiers. Qualifiers will not be applied to the hard copy analytical reports.

Field Data Review

Field data are generated from in-field measurement. The quality objective for the in-field measurement activities is to obtain accurate measurements of sample characteristics, including aqueous pH, conductivity, temperature, turbidity and dissolved oxygen, using appropriate equipment. Data are recorded in field logbooks or on field sampling sheets and calibration logs. Calibration logs will be reviewed by ARCADIS

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Field Leader with other field documentation to identify any potential impacts to data quality and usability. Field logbooks are reviewed as part of the QC inspections.

Reconciliation with Data Usability Requirements

Data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Data that has been rejected will not be used. Data that has been qualified but not rejected will be considered useable (i.e., qualified as estimated) and definitive data. If there is an instance where further limitations must be placed on qualified data, the data will be additionally qualified with "X." This would indicate that the associated data is nondefinitive data and should be used for screening purposes only.

Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results, or inconsistent data may include any or all of the following:

- retrieval of missing information;
- request for additional explanation or clarification;
- reanalysis of sample from extract (when appropriate); and
- recalculation or reinterpretation of results by the laboratory.

These actions may improve the data quality, reduce uncertainty and eliminate the need to qualify or reject data. If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- extrapolation of missing data from existing data points;
- use of historical data; and

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- evaluation of the critical/noncritical nature of the sample.

If the data gap cannot be resolved by these actions, the data bias and potential for false negatives and positives can be evaluated. If the resultant uncertainty level is unacceptable, than additional sample must be collected and analyzed.